WoodRat WR5

Handbook V8.3

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Edited and designed by Henry Godfrey

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The WoodRat® has patents and patents pending worldwide.

U.S. Patent No.4 995 435 / Australian Patent No.609826

UK Patent No.036 22 51 / German Patent No.38 80 138.8

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Welcome to WoodRat

Introduction

Fast, accurate and powerful, the router is an amazingly versatile tool, while the selection of available bits grows by the day, opening up new possibilities for the woodworker.

On its own, however, the router is not an easy tool to use. Three things are essential or it gets dangerous: the router itself has to be firmly held: the timber it's cutting has to be firmly held under it, and the cutter has to travel in the correct direction through the wood.

Working with the router to a large extent becomes a business of making jigs to secure the router's position to enable fine work to be done. Jig-making therefore takes over from the real work in hand and becomes an end in itself.

The purpose of the WoodRat is to hold the Wood, and hold the router, replacing that multitude of jigs, and to allow the router to be put into the wood in the correct direction. It guides the router as it slides forwards and back at a precise angle, cutting the wood which is held firmly beneath it. It can also fix the router in the manner of a router-table, so that the wood can be fed into the Cutter. Work can be fed either by hand or mechanically, held in the machine, in a way which is, in effect, power-fed.

Moreover, you can see the cutter as it cuts, and work to a line. The timber movement is finely controlled as it's tracked into the cutter. Within the useful limits, any size of board can be held at virtually any angle and orientation and be cut, profiled, mortised, dovetailed, slotted or grooved.

Because of this there is hardly a joint in the book that cannot be made by the WoodRat, either wholly or in part, with gains in both accuracy and speed.

The delight of working with the WoodRat comes not specially from the complicated things that it can do, but from the way it can do simple, everyday things like dovetailed drawers and panelled doors and do them fast and well.

Your WoodRat is Revolutionary. Here's Why:

- Work is generally held vertically in the machine, so that any length of timber can be held and its end cut from above. This is the most effective way to hold it true and square (you can hold a plank vertically with two fingers, but try holding it horizontally). This allows the router to work in an upright position, where it's easy to get at.
- By adding simple jigs, the wood can be presented to the cutter at almost any angle or position.
- The WoodRats Cam Lock system holds the timber firmly by the edges. This is the quickest way to lock the workpiece in place. The WoodRat is the only machine that uses this method.
- Power feeding is usually an add-on feature of expensive milling machines, but here it is part of the system. Work is restrained as it is wheeled into the cutter. This means that the wood can be milled by using a 'down-cut', giving a perfect cut in any quality of wood without breakout. If you try down-cutting when hand-feeding, the bit will whip the piece out of your hands, with dire results. In some ways this is the most useful feature of the 'Rat.
- The system of Sliding Plates that controls the router is also unique to the WoodRat. It puts the amount and direction of travel under very fine control.

- The Crank Handle driven, Sliding Bar places the wood under the router with Rats whisker accuracy, while at the same time allowing very fast tracking. The Bowden cable has no backlash and no slack due to wear. This means that when the cutter hits the wood there is no movement of the workpiece.
- The WoodRat employs a marking system which allows one half of the joint to become the template for the other half, no matter where the sockets are placed. There is virtually no marking-out for dovetails, which takes such a time in hand work.
- Generally, simple woodworking methods are used, like pencil lines drawn out on paper labels or on the machine itself, and most of the jigs used to extend the WoodRat's range are extremely simple. As far as possible there are no add-ons to buy. The machine's capabilities can be extended by very simple means that you can make up yourself.

The WoodRat comes into its own after the workpiece has been thicknessed and cut to length. Although it will profile like an ordinary router table, its main job is to speed and improve the jointing process. Jointing takes less time, saving money and giving a competitive edge to the commercial workshop. The joints will fit exactly and therefore more strongly. It follows that the timber used can be of lighter section. The techniques tend to be traditional cabinet making methods suited to the use of real wood. This means that the construction can be lightweight and elegant. There is nothing difficult about the way that the WoodRat works. As one WoodRat user put it… ‘After an hour of head-scratching, light dawns and it is all quite obvious’.

This book explores some of the infinite possibilities brought about by what is a new approach to cabinet-making. I hope that you have a very enjoyable time working with it, and if your livelihood depends on making furniture, that it will make a significant impact on your profitability.

Happy ‘Ratting

Martin Godfrey

Martin Godfrey

About This Book

If you're new to woodworking as well as to the WoodRat this book may seem a bit daunting. We recommend that you start simple at first and develop your skills as your confidence increases. Finger Joints, Profiles and Housing Joints are all good places to start once you've set up.

The WoodRat is one of the safest ways of routing, but please read the section on safety (page 20) before you begin work.

We have divided this book into sections, each dealing with a kind of action. For example the Mortise and Tenon joint is covered in two sections:- Tenoning – that is cutting round the end of a plank or board, and the mortise part under Mortising, which deals with chopping holes.

Understanding the technique of tenoning also gives you the understanding of the tenon part of the housing joint and the sliding dovetail, but the slot to take the tenon for these joints is dealt with in the previous section under Trenching.

Language

This manual has been written in British English. If you're American you may find our use of vice for vise, housing for dado cut, or rebate for rabett, a bit quaint, but that's how it is. We did consider making a special American version, but decided against it. Canadian English has subtle differences from American, and the Aussies have subtle differences from the New Zealanders. What really matters is that the meaning is absolutely clear to all, so do let us know if it isn't.

WoodRat Online

The WoodRat web-site is a good place to get up-to-date information about our products and you can even buy them online, wherever you are in the World. It also links to the WoodRat Forum, where you can share your experiences with other WoodRat users, and a downloads section with updates to this book.www.woodrat.com

The Video and DVD

Many of the techniques covered in this manual are also demonstrated in our promotional VHS video and DVD. They are as follows; Finger Joints, Tenons, Mortises, Profiling, Routing Circles, Pin Routing, The Box, The Sugar Tong Vice, The Mitre Box, Batch Cutting, Raising and Fielding Panels, Sliding Dovetail, Through Dovetails and Drawer Front Dovetails.

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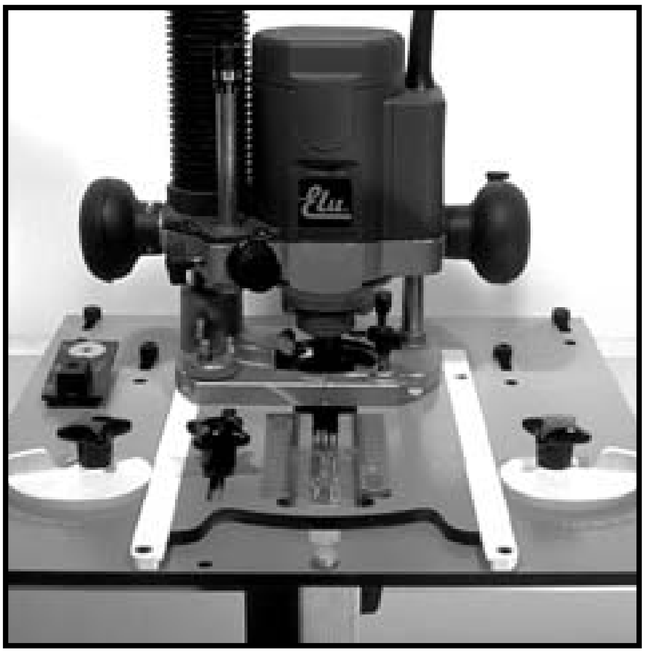
Section 1



Setting Up

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Preparation

Some people never read instructions. WoodRat is simpler than it looks, and we have tried to make the instructions readable and logical, but whatever your approach - please read the section on Safety (page 20) before you cut anything at all.

The instructions are laid out in such a way as gradually to introduce the user to the machine. There's a lot to tell, and it' s best worked out with the machine in place. So…

Decide where the machine will go

Ideally the WoodRat should fix to a Wall-Plate at an easy working height on the wall. You will find that you use it a lot, and for the most unexpected things, so position it as a workstation, close to your workbench and hand tools.

Mounting the WoodRat on the workbench permanently is not a good plan as you will need your workbench to prepare and finish work that is being jointed. You do not want to have to get it out of the cupboard each time you use it.

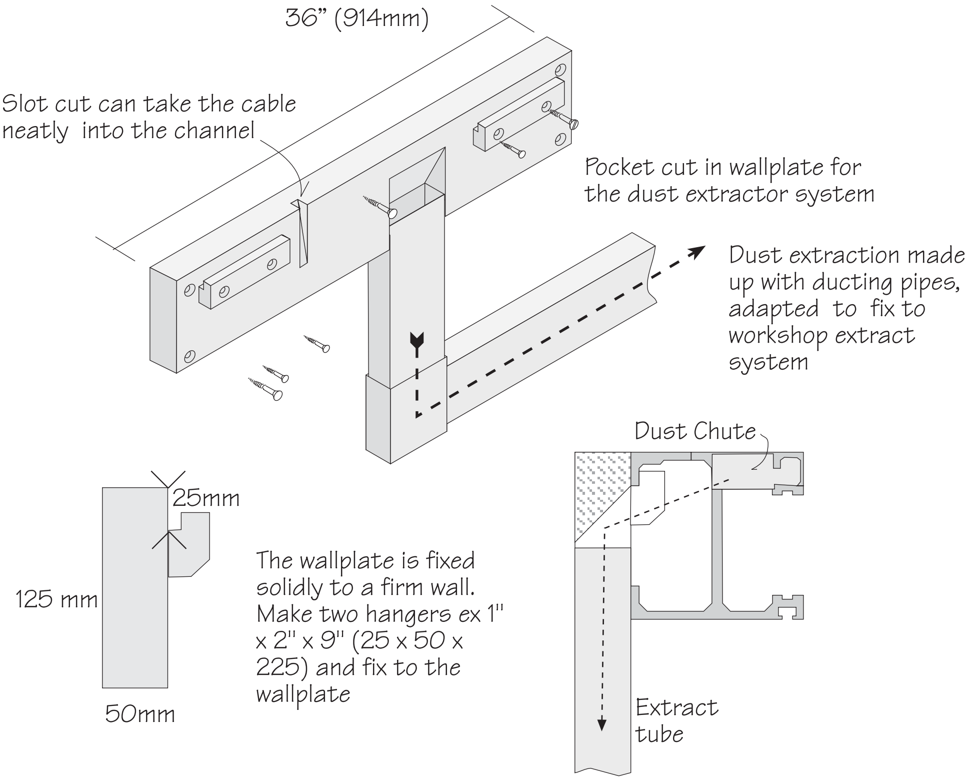
If in doubt, about 15“ below eye level is a good height so that you don’t have to stoop to work it.

You’ll need a space of about 50mm behind the Channel of the machine when it’s wall mounted, so the Wall-Plate is necessary to hang the Channel on and also to keep the Channel out a little from the wall

You will need 2m of clear space for the WoodRat to operate in, and a wider uninterrupted space if you are working on long pieces horizontally. You can of course use the wall behind and below the WoodRat for racks to hang things on

Tip: If you have no wall space, make a solid framing, incorporating a Wall-Plate, to stand on the floor, or on a second bench. With a big router and 50mm straight and dovetail bits, the best way to make the frame is with the WoodRat, so mount it temporarily on the bench.

The Wall-Plate & Dust Extraction

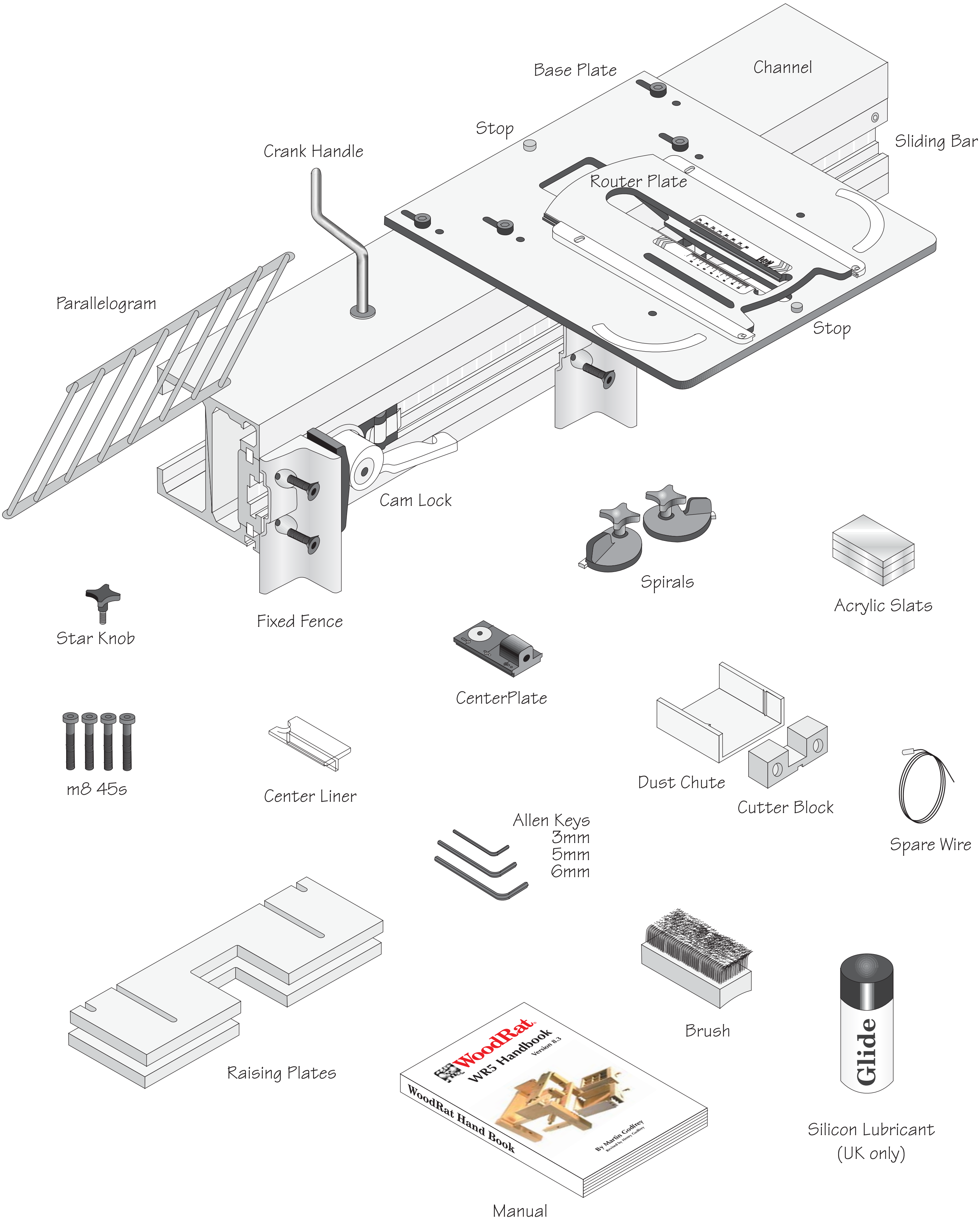

36" (914mm)
Slot cut can take the cable neatly into the channel
Pocket cut in wallplate for the dust extractor system
Dust extraction made up with ducting pipes, adapted to fix to workshop extract system
25mm
125 mm
50mm
The wallplate is fixed solidly to a firm wall. Make two hangers ex 1" x 2" x 9" (25 x 50 x 225) and fix to the wallplate
Dust Chute
Extract tube

Take a 36" (914mm) length of ex-5"x2" (125x50mm) prepared softwood and make up the Wall-Plate as shown on the drawing. Fix it firmly to a solid wall.

Make the hangers from two pieces of 2"x1"x9" (50x25x225mm) softwood and rebate them so that when planted on the Wall-Plate they hold the Channel just level with the top of the Wall Plate. Thus the bottom of the 6mm rebate will lie 25mm below the top surface. If you make the rebate too big the Channel will slope, and the router will run forward. So if it isn't level, pack out the bottom flange with a thin lath, or plane off a little from the hangers. The WoodRat hangs in the rebate, and stays there by its own weight.

The inlet of your extraction system can be fixed to the Wall-Plate, and placed so that it takes dust from right behind the cutting area. When needed, the Channel can be lifted off without disturbing the system. Stuffing rags in the Channel ends is a quick but effective way to direct the intake flow. Better, shape the expanded polystyrene blocks saved from the packaging with your bandsaw. Extractor ducting from your hardware store can be adapted to make an unobtrusive, permanent system

The WR5 Kit


Base Plate
Channel
Stop
Sliding Bar
Crank Handle
Router Plate
Parallelogram
Stop
Cam Lock
Spirals
Acrylic Slats
Star Knob
Fixed Fence
CenterPlate
m8 45s
Center Liner
Dust Chute
Cutter Block
Spare Wire
Allen Keys
3mm
5mm
6mm
Brush
Raising Plates
WoodRat
WR5 Handbook
Version 8.3
WoodRat Hand Book
By Martin Godfrey
Glide
Silicon Lubricant
(UK only)
Manual

Identifying Parts

Parts List

1x Aluminium Channel with Sliding Bar and Handle in place.

2x Fixed Fences

2x Cam Locks (sliding fences)

1x Base Plate

1x Router Plate

1x Centre Plate

2x Orange Stops

2x White Guide Rails

1x Clear Centre Liner

2x MDF Raising Plates

1x Blue Cutter Block

3x Star Knobs

2x Spirals

1x Yellow Dust Chute

1x Spare Cable

3x Allen Keys

1x Instruction Manual

1x Brush

1x Silicone Lubricant

1x Parallelogram

Not Included

Mitre Box (accessory)

Mortise Rail (accessory)

The Box (workshop made)

Wall Plate (workshop made)

The Batten (workshop made)

Cutters (available from WoodRat)

Video (available from WoodRat)

The Channel

The Channel is made of an aluminium extrusion anodised grey. When registering the position of the workpiece - the Channel serves as a kind of note-pad, with pencil marks made upon the machine itself. The marks can be easily cleaned off with a soft eraser.

The top surface is the ‘Channel Top’, and the front surface is referred to as the machine or WoodRat ‘Face’.

Please note: The top and the face are as they come from the extrusion process. That is they are not milled square to each other. If they were, you would have paid considerably more for your WoodRat. However they should be reasonably square and adequate for woodworking. It’s possible to shim the Base Plate, to level it more accurately. Card fixed to the Channel with doublesided tape will work well.

The Sliding Bar

The Sliding Bar takes the two Cam Locks that, together with the Fixed Fences, hold the work. Wood in the left hand Lock is said to be in **Marker Position**, and work in the lock on the right is said to be in **Cutter Position**.

Sometimes you use one lock, sometimes both, and sometimes you remove the right-hand fence, and are thus able to put in work-pieces up to 30” wide.

A little silicone on a rag, rubbed into the slide-ways will give easy travel for the Cam Locks.

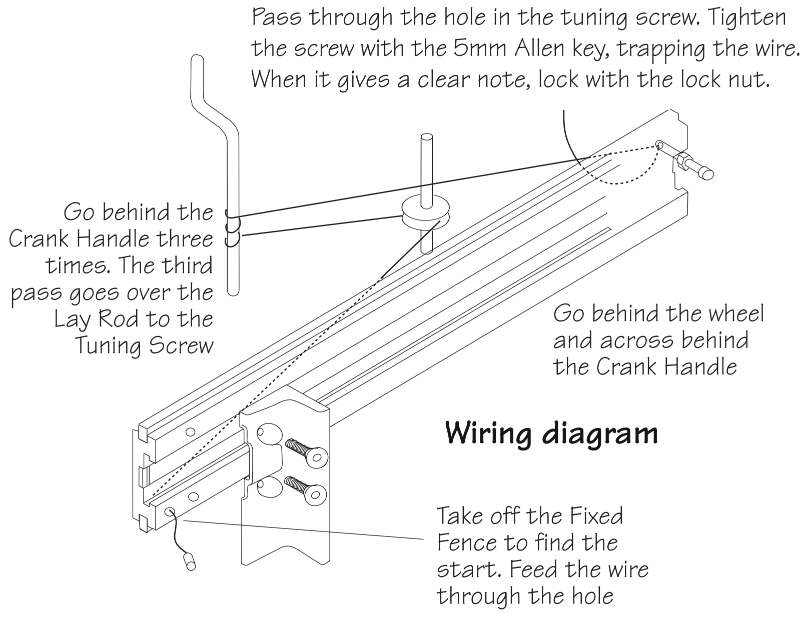
Check that the sliding bar moves freely by turning the Handle. It should be possible to make very fine adjustments to the position, and this depends on the Tongues sliding freely in the grooves in the Channel without juddering. The Sliding Bar does need to have some friction between it and the Channel and this is given by the pull of the wire. If the Bar gets awkwardly stiff, the wire will slip on the Crank Handle shaft, so lubricate tongues and grooves with liquid silicone or spray.

Rattle in the Bar

When you put the workpiece into the Cam Lock you will find a slight movement or rattle in the Bar. Eliminate this by hooking your fingers round behind the Fixed Fence and pushing on the workpiece with your thumb while pulling the fence forward with the fingers as you tighten the Cam Lock. The workpiece will now lie solidly against the face of the WoodRat.

Tip: Some slackness can be eliminated by tracking to the extreme left, lifting the top plastic guide from its slot in the sliding bar as far as possible and tracking to the right to re-seat it (and repeating on the right). It then tracks much better with less slack.

The Crank Handle and the Bowden Cable (the Wire)


Pass through the hole in the tuning screw. Tighten the screw with the 5mm Allen key, trapping the wire. When it gives a clear note, lock with the lock nut.
Go behind the Crank Handle three times. The third pass goes over the Lay Rod to the Tuning Screw
Go behind the wheel and across behind the Crank Handle
Take off the Fixed Fence to find the start. Feed the wire through the hole

Wiring diagram

The Bowden cable goes from the left-hand end of the Sliding Bar, round the Wheel on the Lay Shaft, and is then wound back round the Crank Handle Shaft three turns.

It is then attached to the right-hand end of the Bar, where it can be tightened using the 5mm Allen key in the Tuning Screw. When plucked, it should give a clear note, but not be too tight. The Bar should travel easily by the Crank Handle but be difficult to dislodge if pushed by hand. If it is too loose there is a danger of the cutter dislodging the work as it cuts. If it is too tight, the wire will slip on the shaft.

There’s a spare wire in the kit, in case yours should break.

The Fixed Fences

1. Using the 5mm Allen Key, place one of the Fixed Fences (they are both the same) to form the left-hand Marker Fence on the Sliding Bar. Check for squareness against the Channel top.
2. Place the first Cam Lock before fitting the second Fence! Put the handle of the Cam Lock through the ring (the Keeper) on the Sliding Fence, and feed the toes of the Sliding Fence and the base of the Traveller into the slide-way on the Sliding Bar.
3. Place the Fixed Cutter Fence as described for the Marker Fence and fit the second Sliding Fence and Cam Lock Assembly.

Correcting the Fence

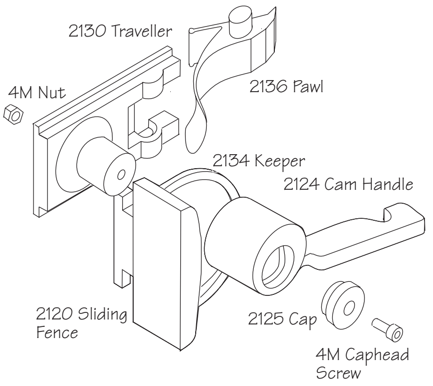
If the fence is not exactly square, loosen the Countersunk Screws, and tap the fence into line and re-tighten. This should be enough.

Sandpapering your face

You may find that there is too little friction between the work-piece and the Fixed Fence. This can be simply remedied by gluing a piece of sandpaper to the face of the Fixed Fence. Spray adhesive or sticky backed glass-paper work well for this.

Note: Some diagrams in this book show the old style of Fixed Fence.

The Cam Lock



The Cam Lock handle tightens upwards, unlike a door handle. This way, the workpiece is not pushed upward as it closes. The Lock does not need a lot of force. Some soft woods will be squashed by camming them too hard.

You may find that the Cam Lock does not hold the boards satisfactorily or that it tends to pop open again. It could be that the cam handle has worked loose on the post. There needs to be a little friction in the system to hold the cam in place. So tighten the M4 cap head screw on the cap a little.

The Allen Keys

Just three Allen Keys: The 6mm key tightens the cap-head screws for the Base Plate and doubles as a Stop when making drawer-front dovetail pins and other stopped cuts.

There is a 5mm key for the Fixed Fences and for tuning the Wire.

There is a 3mm key for the small cap-head screws that hold the Button and also the Guide Rails.

Tip: Be careful not to over-tighten any bolts, thus stripping the threads.

Cap Head Screws

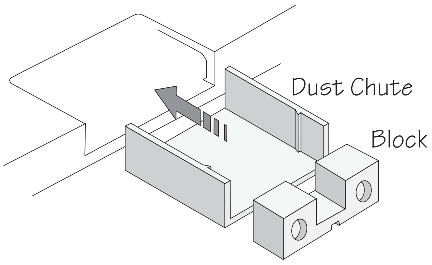
4 x M8 25 to fix the Base Plate to the Channel

4 x M8 45. These will be used to fix the Base Plate when you need a greater clearance in the Cutter Gap, and raise the Base Plate with the Raising Plates.

4 x M8 Countersunk screws used to fix the Fixed Fences to the Bar.

2 x M8 30 with 2 x M8 Nuts. These are to fix the Batten (not supplied) under the WoodRat to allow registration of tail and pin positions when working wide boards.

Dust Chute and the Cutter Block



Before you attach the Base Plate, drop the Dust Chute into the cutter opening. Make sure that the front of the Chute is flush with the machine face. Otherwise sand it carefully until it is flush.

The Cutter Block (used when hand feeding) will push fit into the Dust Chute. It should also be flush with the face of the machine.

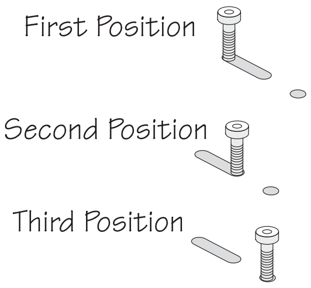
Place the Base Plate Assembly

Screw the Base Plate to the top of the Channel with the four 25mm cap-head screws (4x M8 25’s). The four larger cap-head screws (M8 45's) are for use with the Raising Plates.

Because the WoodRat copes with such a wide range of wood thicknesses, there are three positions for the Base Plate:

First Position:

The first position is for large work: Place the M8 25 cap-head screws in the slots, and pull the Plate forward to bring it to the first position. Then tighten the screws. This gives more room for the forward travel of the bit.



Second Position:

The second position is for medium work. Most work will be done using the middle position. Undo the screws and push the Base Plate away from you in the slots, and tighten.

Third Position:

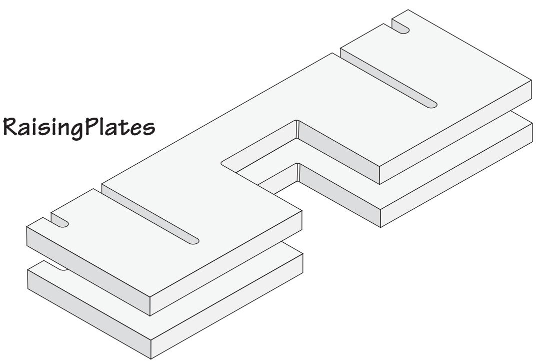
The smallest work is done in the third position with the Plate set further over the Channel. When using the two smallest cutters, place the screws in the holes in front of the slots.

Squareness.

Since bolt holes/slots allow a little movement, it's important to make sure before final tightening that the Base Plate is square in relation to the Channel.

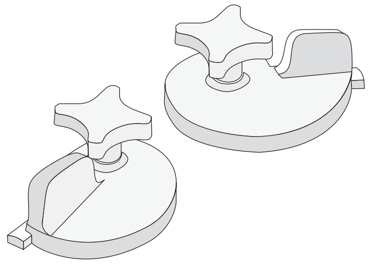
Important: Never leave the router out on the Base Plate at the end of the day, it’s weight could bend the Plate over time. Push it back onto the Channel.

The Raising Plates



When working timber over l” (25mm) thick, you will need to raise the Base Plate, to a greater depth of cut. This is done by sliding one or both MDF Raising Plates between the Base Plate and the Channel top. You will then need to fix the Base Plate with the longer M8 45 cap-head screws supplied.

Spirals



The two spiral cams are fixed with the star knobs on either side of the Base Plate and they are used with the Centre Plate. Note that their rounded sides go against the router Plate, and control its angle. They have a clear acrylic cursor to enlarge the reading on the dials. The left one will also be brought further “in”, off the scales, to make the router Plate travel square to the WoodRat Face (that is at 90°).

The Dials

The dials are not really measures of degrees, as they cannot tell you the actual angle of the Router Plate, (you will see that if you fix the Spiral and move the Button and Centre Plate, the angle of the Router Plate will change even though the dial reading stays the same).

Place the Stops

Insert them in the holes in the centre of the front and rear edges of the Base Plate. These prevent the router cutting the Base Plate when cutting at angles, so always be sure that the Front Stop is in place when making dovetail pins.

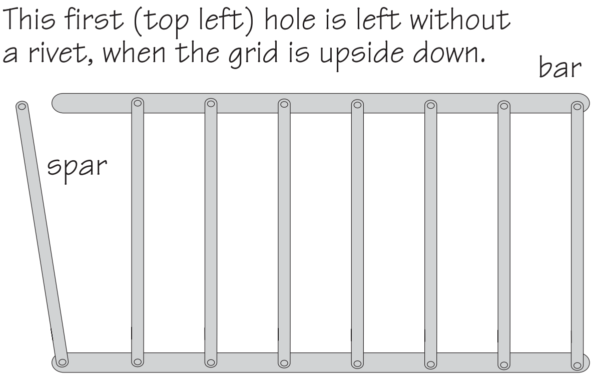
If you ever lose a Stop, an 8M caphead screw will serve.

Guide Rails

The Guide Rails fit to the Base Plate with the four M4 10 cap-head screws on either side of the Router Plate. They allow the router to come right to the front of the Base Plate, cutting square, when making tenons, housings and other joints. Note that the rear holes are slotted to allow a slight taper to the cut on either side. See tapered dovetails later.

The forward travel is 225mm or 9" with the Base Plate in the second position, and 250mm -10" if brought forward to the first position. This will therefore make a stopped sliding dovetail in an 11” (275mm) shelf.

The Parallelogram


This first (top left) hole is left without
a rivet, when the grid is upside down.
bar
spar

This unique system gives you adjustable parallel lines - useful when marking out joint spacings. It comes in pieces, eight short spars to be fixed top and bottom to the two long spars using the rivets provided to form a grid.

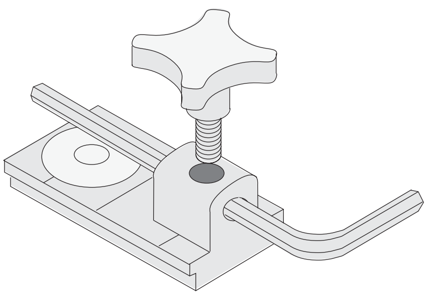
1. Lay one large spar upside down on the work-bench, and place one of the small spars upside down on top of it, aligning its hole with one of the holes in the bar (Do not chose the first hole which will be left without a rivet).

2. Tap a rivet through the small spar pinning it to the larger spar. It should snap into place.

The end of the rivet will project through and hit the worktop, so it is best to tap it home with the rivet located over a small hole or depression in the benchtop, to give it room to pop through.

3. Tap home all the rivets in all the spars, both ends, (but put no rivet in that first top left hole). Turn the whole parallelogram over top-side up, and fix it to the Wall Plate top with the wood-screw provided. The further back the screw fixing goes the better. The top right-hand corner is now fixed and the grid can swing forward so that the bars are square on, and the grid can expand and contract over the top end of a board when it is clamped in the Marker Position. For an illustration, see the Dovetailing section on page 87.

The Third Star Knob



Two Star Knobs fix the Spirals. There is a third Star Knob which has two functions.

Function 1

To fix the Router Plate down to the Base Plate. There are two tapped holes in the Base Plate for this.

Fix the Star Knob through the Router Plate and into the tapped hole in the Base Plate. You will find that it fixes the router Plate firmly to the Base Plate either with the Centre Plate in place or with the Guide Rails in place.

Function 2

It fixes the Allen key in the Centre Plate. This is the basis of the Stopped Cut (more on this later) used in Drawer-Front Dovetails etc.

Place the allen key in the horizontal hole in the Stop Block, and screw the Star Knob in the vertical hole to fix it down. You will see that as the router comes forward it is stopped by the Allen Key.

Acrylic Slats & Blu-Tac

A cut made in a slat of acrylic gives the depth and shape of a cutter - useful when marking out the position of cuts. To avoid meltdown, always use a sharp bit. More on this later.

Blu-Tac is a British product. It’s a type of putty used to stick paper to walls. On the WoodRat it can be used to attach acrylic marker slats to to the Router Plate for North/South registration. In the United States, it can be bought from Staples Office Supplies. They call it Tac n' Stik and it is available from their web site (www.staples.com). Double-sided sticky tape can also be used.

Setting Up Your Router

Which Router to use

The WoodRat works with any make of hand-held router, having a 1/4" collet, or taking the larger 1/2" collet, up to about 2hp. Beyond that, 3hp routers with big circular bases can be used, but may limit the flexibility of the machine a little.

The WoodRat 8mm shank dovetail bits work in stock up to 32mm thick, so a 1/2" collet is necessary for work over that depth. The larger router will do the smallest work but the small router cannot do the larger work. The types with soft starting are best to work with, as they don't kick when starting up. Otherwise choose one for its low noise level, easy plunging action and ease of changing the cutters.

Attach your Router to the Router Plate

Routers generally have tapped holes in their bases to take guide bushes, or other holes for fixing the router to other attachments. We have found that these guide bush holes are quite satisfactory for fixing the smaller routers to the Router Plate, if no larger holes are available.

There is a great variety of routers on the market each with its own base sizes and hole positions, so you may have to drill and countersink your own holes in the Router Plate. You will find starter holes for some common makes.

Make sure that your drilling is accurate and that wherever the fixing holes need to be, the router axis ends up close to the axis of the two pre-drilled inner starter holes on the Plate. If you gauge a thin scratch with your cutting gauge from either side of the Router Plate, you will easily be able to centre the router. A large router will overlap the Router Plate without causing problems.

Your router may have a phenolic sub-base. Take this off and use it as a template to locate your holes and then store it.

Important: *Drill from the top surface, but don't forget to turn it over to countersink it from below. Also; Remember that we supply spare parts so a mistake at this stage won't require a whole new machine.*

Bosch 800/900/1300 ACE, 1613 /1614EVS

If your router is a Bosch 800/900/1300 ACE or 1613/1614EVS , you will find that the normal mounting position leaves the router's base covering the Centre Plate. You will need to mount the router slightly further back on the Plate to avoid this.

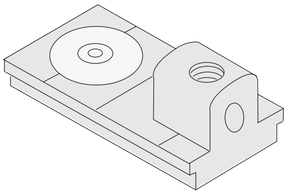
The Jacobs Power Collet

Note that the Jacobs quick release collet shown in the Video is no longer available.

The Centre Plate Assembly

Try the Centre Plate in the Router Plate tee slot. If it seems tight, ease it with a little silicon fluid. If it is still tight, very gently ease the little blips on the edges of the Centre Plate with emery paper or a file, try again. It should slide fore and aft without any sideways slap so be careful.

To fix the Router Plate to the Base Plate:

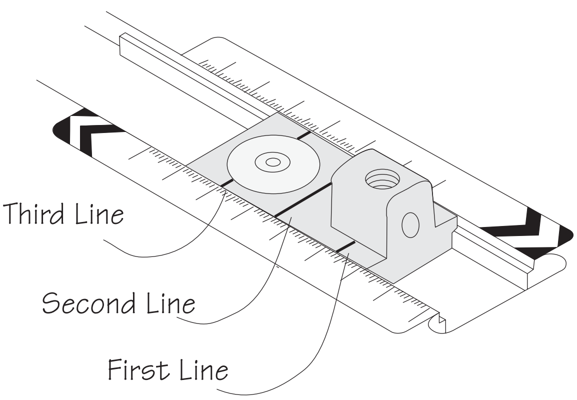


Place router and Router Plate onto the Base Plate. Slide the Centre Plate into the Tee-slot in the Router Plate.

Undo the caphead screw a little. Nose it forward under the router base, and then bring it back so that the Tee Nut can engage in the tee slot in the Base Plate, and tighten the screw in the Button.

For some functions the Centre Plate is "in", and for some it is not used at all. The Router Plate is then kept in line by the Guide Rails. **But always use one or the other. Sometimes both, never neither !**

The Button and Centre Plate Settings



The Button in the Centre Plate makes a pivot around which the Router Plate swivels. The distance of the centre of the screw in the button from the face of the WoodRat is the key to the exact fitting of pin to tail when making through dovetails. The button position relative to the face of the WoodRat, is found by registering the lines drawn on the Centre Plate, against the scales on either side of the Router Plate.

The Router Plate moves about, so you have to fix the Plate first by moving it against a Stop. You can push it right back against the Back Stop, in which case you register against the scale on the left-hand side of the Router Plate, or bring the Router Plate forward against the Front Stop, in which case you register against the scale on the right hand side of the Router Plate. It says this on the scales.

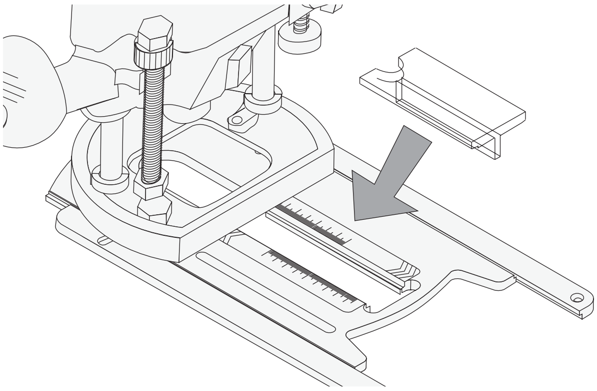
Since there are three positions for the Base Plate, there needs be three cursor lines on the Centre Plate.

When the Base Plate is brought forward in First Position, for large work, the first line is used. The Second Position uses the middle or second line, and for small work you use the lines opposite the screw in the button itself. Third Position: third line.

You will find three little icons, one on each line, which remind you which is which.

The Centre Liner

…a clear acrylic tee-shaped piece that fits into the tee slot of the Router Plate



When you are cutting to a line with a saw it is easy enough to see where the cut will come. With router work it is more difficult to see the exact line of the cut because the cutter makes a rounded kerf.

You'll need to be able to bring a line on the workpiece to centre on the cutter, and be confident that the router will cut exactly down it. This is the purpose of the Centre Liner. It is mostly used with the Guide Rails in place.

You may find it useful to rub some ink into the line on the bottom of the cursor, so you can see it more easily.

Just testing:

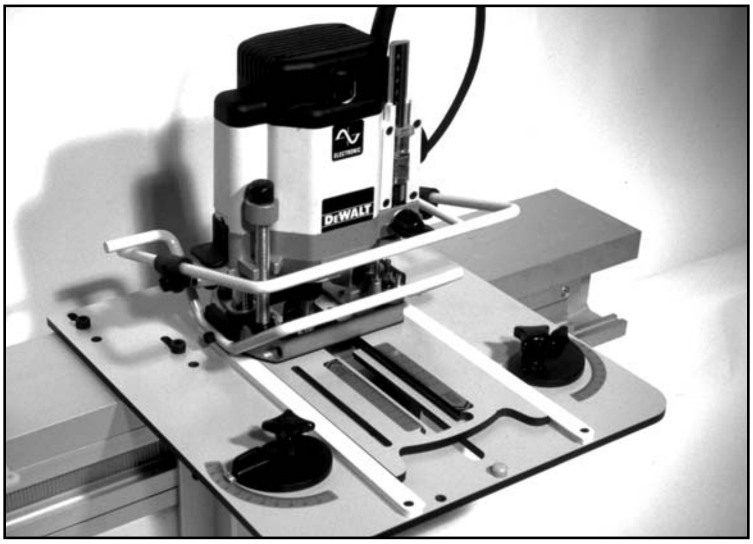
1. Place the Centre Liner in the Tee slot in the Router Plate. Its edges may need a gently sanding to fit it to the slot.
2. Mark up a piece of scrap rail with a line across it. Bring the line up below the Plate. Track it left and right until, by looking through the centre liner you can see the pencil line below. Place the marked line exactly under the line on the cursor. Clamp the scrap rail to the Base Plate and pull the centre liner out of the way. Pull a cut a little way down the pencil line, and check that the cut is central to it, and that the centre liner is giving you the accuracy that you need. Use your smallest cutter for this exercise.

Holding the Router

Routers are designed with two big handles for you to hold on to firmly as you cut. This may be fine for freehand work, but the WoodRat likes a little more finesse.

As you cut, we recommend that you hold the router with your right hand round the body of it rather than by the two handles. Or, if you have a PlungeBar, hold on to the lower bar.

Using the WoodRat PlungeBar™



PlungeBars consist of two or three steel bars which fix to your router above or in place of the handles and to the base. When squeezed together, the router is plunged with only one hand.

This allows you to depth the router as necessary with the right hand while the left is free to work the Crank Handle, which is excellent for mortising.

Safety

General

- Wear Safety Goggles and do not look beneath the Plate when making a cut.
- Arrange a vacuum dust extraction system to take the harmful, fine dust from behind the cut. (See page 9). Or wear a dust mask
- Read the instructions that came with your router.
- Do not use a router when tired or under medication that may cause drowsiness.
- Disconnect router from mains supply when changing cutters.
- Use either the Guide Rails or the Centre Plate and Spirals, or both, but never neither. The Router Plate must be held in one of these ways.

Hand-feeding

There are special requirements for Profiling, Grooving & Rebating. Read the relevant section before you try them.

- When passing work through a fixed cutter by hand always use the Cutter Block in position.
- Always check that the Router Plate is screwed securely to the Base Plate with the Star Knob.
- Do not attempt to hand feed small or awkward pieces. Devise a carriage that can be held in one or both Cam Locks and track it through the bit.
- Always enter the wood into the router bit in the correct direction. That is against the cutter blade rotation, as explained in the text.
- When holding a piece and feeding it through the bit, never hold it in such a way that if the piece were to be whisked away by the bit the hands would be exposed to the cutter. This could happen if you get the direction wrong.

Grooving

- Having made one grooving cut down a length, be extremely careful if you are widening the groove. The next cut must be an up-cut, ie. against the cutter blade. The bit goes clockwise, and the direction of the pass will depend on which side of the trench is being widened.

Mortising

- Take special care when plunging into the work when drilling holes and making mortises. Ensure that the work is very firmly fixed in the Cam Locks, and proceed slowly with a sharp bit with good end cutting ability.

Fouling Your ‘Rat - Three Warnings:

1. Wide Cutters:

Do not use cutters of more than 13mm, (1/2”) diameter for cutting long housings as you will endanger the long slot in the Base Plate! If you want to make long cross-cuts with big cutters order a second Base Plate from your WoodRat supplier and modify it.

2. Big Dovetail Bits:

Be very careful when making sliding dovetails with large dovetail bits. They may cut the wood without cutting the Base Plate when they are fully depthed, but might chop the Base Plate when they are un-plunged.

3. Loose Parts:

Never make a cut with the spirals loose or widely spaced as you may cut the Base Plate. So…

This is a vital exercise:

- Run the router around the Plate (switched off and un-plunged!) and see how far out you can open the Spirals without any danger of cutting the Plate. Slacken the Centre Plate and bring it forward and try again.

Section 2

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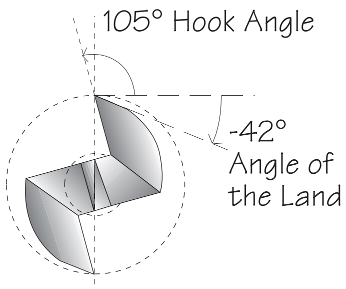
Perfect Cutting

Introducing High-Speed Steel

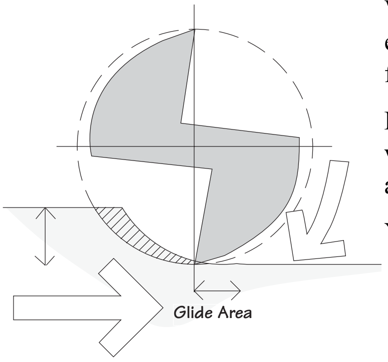


Most of the world uses Tungsten Carbide Tipped Router Bits yet WoodRat recommends High Speed Steel. Why? - The two steels are entirely different. High Speed Steel is more flexible and less brittle and, although it does not retain an edge for as long, it's easier to sharpen and to hone to a fine edge. High Speed Steel tends to go blunt, tungsten is harder, but more brittle, and tends to chip. Because of this, Tungsten Tipped cutters are made with a straighter cutting angle or rake. This means that they tend to push rather than slice their way through the wood. This is best for going down the grain for profiling and rebating (the sort of action that a router table is used for).

On the other hand HSS is favourite for real-tree wood, especially when going across the grain, and making joints in the ends of planks and rails. Here, the higher rake and sharper edge gives a better cleaner cut. High Speed Steel is also essential for cutting plastics and soft metals like brass and aluminum.**Note:** *TCT cutters are necessary for working plywoods, particle boards and MDF boards. These boards are packed with resourcinol glues and abrasive particles of all kinds that would make short work of a high-speed steel bit going at router speeds. Here the harder steel is essential.*

More on HSS on page 101.

The Up-Cut (Tearout)

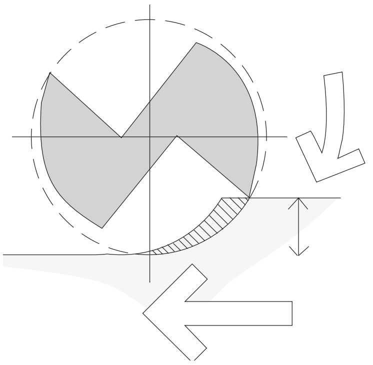


With the wood fed into the cutter against the spin of the blades, the cutting edge scoops upward through the wood, and finishes by splitting off a chunk from the surface - ‘Tearout’.

Down the grain this may not be too bad, but, across the grain it ruins the work, (you get furry shoulders to the cut). As the cutter gets blunt the situation gets worse.

Yet this is the only way to hand-feed wood into a router cutter.

The Down-Cut (No Tearout)



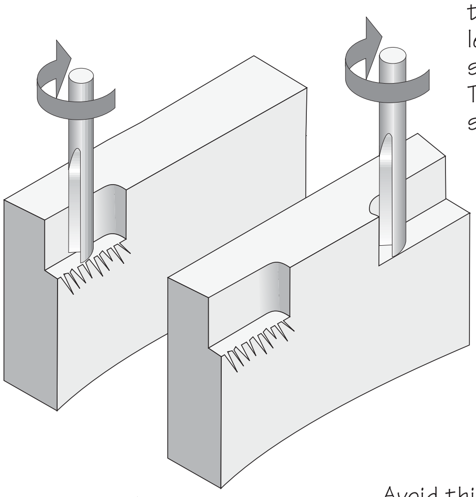
Going in the opposite direction - with the spin of blades - the shoulder of the cut is made by the downward shear of the bit against the intact material, so there is no tearout along the shoulder of the cut.

Furthermore, the force of the cut is downward, in the same direction as the holding down force, which makes for a steadier cut. You can cut deeper and faster with this method.

To down-cut always track the cutter clockwise around the wood and the wood clockwise around the cutter.

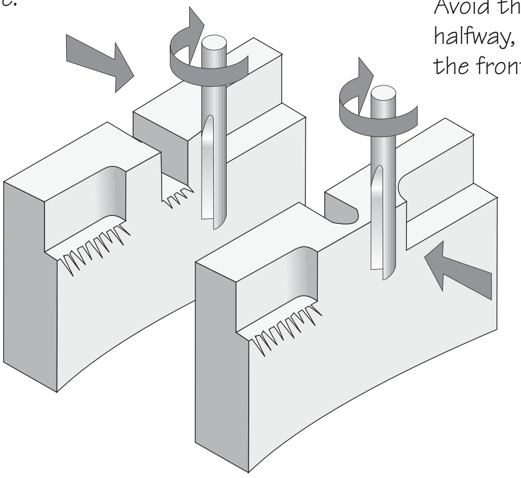
Do this only when the wood is held in the Cam Lock.

Up-cut/Down cut Test



1. Cut on the up-cut: The wood goes into the spin of the blades from the right. This produces bad breakout

2. Cut on the down-cut. Wood goes into the blades from the left, going with the spin of the blades. This gives a clean shoulder to the cut.



3. The cut from behind gives breakout on the front edge.

Avoid this by first cutting from behind halfway, and then finishing the cut from the front.

Set-up: Do this with the Guide Rails in place.

1. Place a 1/2”, (13mm) straight bit.

2. Zero the cutter. Set the depth stop 3/4”, (19mm) and tighten it.

3. Put a piece of scrap board in the Cam Lock and track it into the cutter from the right (on the up-cut). Fix the cutter so that it cuts the front edge. You will see that it produces tearout. Stop.

4. Release the router, bring it forward, track the board left and reset the router as before. Now track the board from the left (on the down-cut). OK, no tearout.

This is a useful test to check whether the cutter is sharp, and how prone to break-out is the wood.

5. Now bring the cutter from behind the wood. Cut through the wood, and see how it breaks out on the front. Make another cut a little away from that one, but stop half way through.

6. Now, push back. Raise the router. Bring it forward to the front of the wood. Depth again onto the depth stop, and push the bit into the wood from the front. There should be no tearout on the front nor on the back.

More Ways to Beat Tearout

Throughout this manual we stress the need to enter the wood into the blade in the right direction, but the following points should also be borne in mind.

- Enter the bit into the wood slowly and exit carefully. Where possible make a rough cut a little away from the line and then make a fine cut exactly on the line.
- Stack the two outside faces of the Sides together inside when cutting dovetail sockets so that when put outside again there is no tearout showing. In fact the tails do not break out much as the cut is an upward spiralling action due to the cone shape of the bit.

Most tearout occurs in soft woods like pine, and mostly when using the straight bit. Scribing the shoulder line makes it worse. Taping it is time consuming. Putting blocks against the bit as it comes through is unpredictable but…

Pre-cutting

There is a simple alternative to all these. You can pre-cut the front of the board as you go, making a cut at each joint position. Then you cut the joint from behind the board in the usual way. Since there is nothing on the front face to break out, the joint is perfectly clean. By this means you can eliminate break-out in virtually every situation.

Sharpening HSS

The more blunt the cutter gets, the more likely it is to heat up, burn the wood, lose its temper or even break. If there is even a hint of the cutter heating up, stop and sharpen the bit.

HSS can be sharpened with a Diamond Whetstone, however it is possible to do a lot of sharpening without much success. Sharpen the cutter by laying the ‘land’ of the cutter (the flat part of the outside edge) onto the wetted stone, and gently work backwards and forwards. If the water goes black, you’re taking off metal. Test the blade by carefully scraping your finger nail. If it takes off nail, you know it’s getting sharp. The land should be polished shiny by the diamonds.

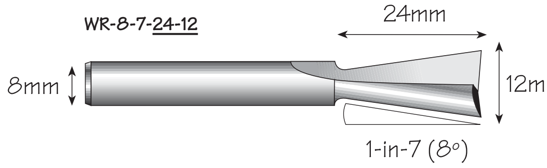
Lay the inside edge on the stone and clean off any wire edge or burr.

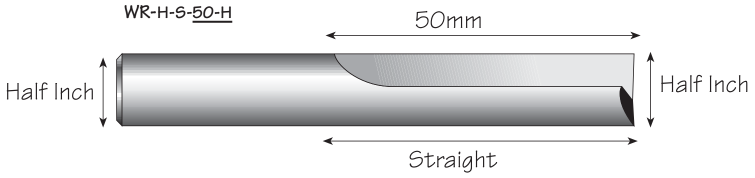
Fine grade and extra-fine diamond whetstones will give a finely honed finish. A pair of powerful magnifying specs could be useful to check the precision of the edge. If chipped, you may want to begin with a coarse stone and work up to the finer grade stone to finish.

Breaking Cutters

If you are constantly breaking bits, the first suspect is not the bits, but the bearings of your router. Check them for wear before replacing your cutters.

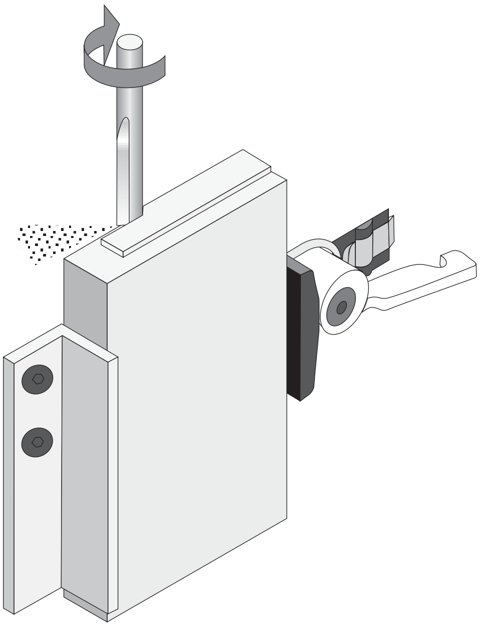
Identifying WoodRat cutters





All WoodRat cutters are identified by a series of numbers or letters according to their dimensions. For example, the WR-8-7-24-12 has an 8mm shank, a 1-in-7 slope a depth of 24mm and diameter of 12mm. The last two numbers are unique to each cutter, so you can simply refer to the WR-8-7-24-12, as the 24-12.

Mowing a Board End



One of the simplest, but most useful, tasks is simply to clean off the end of a board, square and tearout free.

The surface tends to look like a mown lawn, but this can be finished cleanly with a sharp plane.

If a stack of pieces are clamped together and "mown" flat with a sharp bit, they will all be exactly the same size square and true. They are then ready to be lifted up under the Base Plate and all cut together.

1. Put in a straight cutter (of any diameter but with a good sharp end cut).

2. Put a scrap of rail or board in the Cam Lock, right up against the Face. Put the fingers behind the Fixed Fence and pull, and at the same time push with the thumb on the board, to take out any rattle between board and WoodRat face.

3. Zero the cutter. Lift the router's depthing rod foot by 6mm, tighten, and then drop the router onto the depthing rod. This will depth the bit by 6mm.

4. Switch on and track the router bit into the wood going along the front edge. If the board goes to the right you will down-cut the front edge neat and clean. Carry on around the left-hand edge, moving the router away from you. When the cutter reaches the back edge, move the work to the left, and so on round. Then mow the middle flat, going backwards and forwards as you wish. This should give a clean board end without tearout.

Having mowed the end of the board, replace it up under the Base Plate. It should lie snugly up under the Plate. Now turn the piece over: left edge to right, and it should still lie snug against the Plate. If not, the fence is not square and will need to be corrected.

Dealing with Bowed Boards

The WoodRat has the advantage that the work can be prepared and quickly jointed before it has had time to move. The structure of the furniture, if it is well designed, will keep the workpiece straight. That's the theory.

In practice, it is possible to take out the bow in a plank with the thumb of the left hand pushing the centre of the board onto the Bar. If it is not possible to take the bow out with the fingers, then it could be argued that such a board needs planing flat anyway. The fingers are placed behind the Fixed Fence, pulling on the fence and sliding bar, and the thumb keeps the wood flat. Check that your thumb is well clear of the bit.

Tip: This is also a useful place for the thumb when cutting good boards as you can check that all is secure and the cutter has not pulled the board forward.

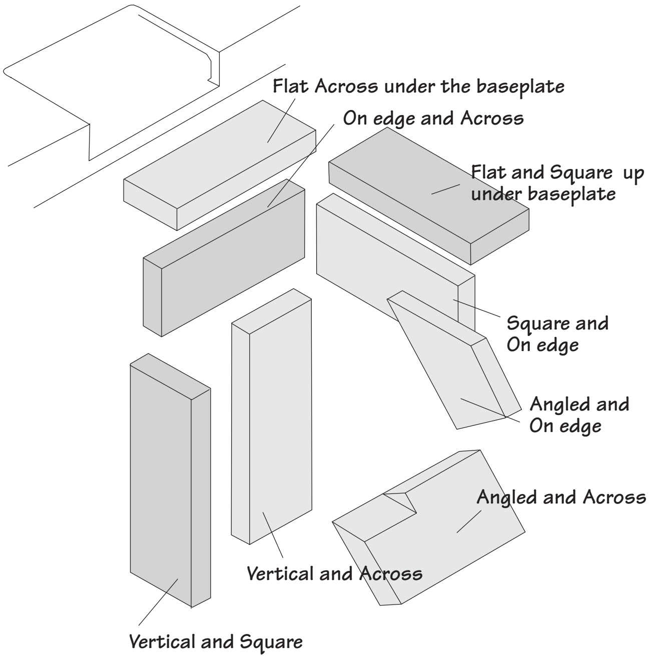
If the board is concave, lock the edge in place tight and flat at the right-hand, sliding fence edge, and then push the left-hand edge flat. The Bar might need assistance to move it, but the board should go dead flat.

It is also possible to flatten a board by putting two battens across it, and clamping them together to flatten the board, before locking it in place. The clamps have to be clear of the Fixed Fences of the WoodRat.

Man-made Boards

We may put a lot of emphasis on the use of High Speed Steel Bits and the ‘Rat as a means of making furniture properly with real wood. However, using Tungsten Tipped Cutters, the WoodRat will cut MDF and plywoods perfectly well. It will also tackle plastics and acrylics and cut them accurately and fast. The WoodRats ability to control tearout is particularly useful when cutting plywoods and material with cross ply layers. Its ability to adapt to new and unusual techniques makes it a tool for modern furniture, just as it will work with the traditional.

Terms Used



Surprisingly, there are no proper names for the ‘way up’ that the timber lies in a piece of construction. A piece may be horizontal, but you have to qualify whether flat or on edge. Even words and phrases that you might think are obvious can be meaningless to others; so we need a few simple definitions.

Therefore:

Flat is as a pancake. as opposed to **On Edge**

Facing is as a building might be facing you.

Across is as a log is across your path.

Vertical is upright, but might be **facing** or **square**.

Square is sticking out at right angles - 90° to the machine.

Angled means at an angle which may, or may not be 45°.

Up under is pressed flat, horizontal, up under the Base Plate.

Somersaulting a board is up-ending it square to you, that is turning it over as one might turn a somersault head over heels.

Cartwheeling is up-ending a board by turning it over facing you as you might watch someone else turn a cartwheel.

Turning a board is like turning a page on a book

Dropped is brought down a little way from the Plate, and re-cammed in the Cam Lock firmly against the face.

East/West is left and right, and **North/South** is forward and back - looking down on your machine.

Joggled is when a joint fits all its pins into tails, but the two boards are not precisely aligned.

Depthing the Cutter

Some Terminology:

Plunging the bit we take to mean pushing down on the router to lower the bit to cut.

Depthing the bit is setting the depth of the cut with the depthing rod.

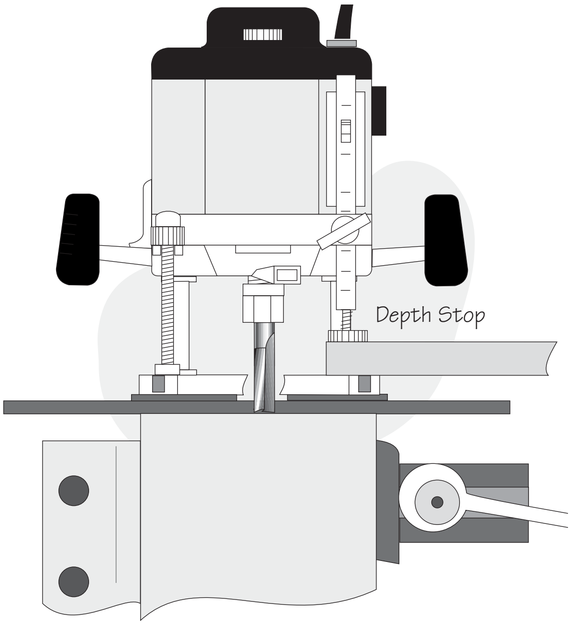
We highly recommend that you use a WoodRat PlungeBar with your router. It turns the two-handed pushing action common to all plunge routers into a single handed squeezing action, that puts no pressure on the work. It's not essential, but makes life a lot easier.

Here are some ways to depth the cutter:

The depth of a joint depends on the thickness of the board that will be joined into it. Remember, it's the marker board that's measured not the board that's being cut (the cutter board).

1. Hold the Cutter Board underneath the Marker Board. Fan them a little apart, and press them both up under the Base Plate. Plunge the router (switched off!) down past the marker board and onto the cutter board, and then lock the router. If you don't have three hands, or a PlungeBar, this can be quickly done by putting the fore-arm over the top of the router to plunge it, while holding the boards up under the Plate with the other hand. The free hand can then tighten the router lock.
2. Hold the Marker Board up under the Base Plate, and push the Cutter Board up under it. Lock it in place. Pull out the Marker board and plunge down onto the top of the Cutter Board. Lock the plunge mechanism, and then raise the Cutter Board up under the Plate. The cutter is now depthed to the depth of the Marker Board.
3. Feel the tip of the cutter with the finger, as you depth it beside the marker board (with the router switched off, of course).
4. Use the depth stop, thus:

Zeroing the Cutter



This is the easiest way we have found to depth the bit, particularly if your router is fitted with a WoodRat PlungeBar:

It might be as well to take the router's turret off and store the pieces, to make things less cluttered. In which case, depth the stop onto the top of the router base.

1. Place the Workpiece up under the Base Plate. Plunge the cutter on to the top surface of the workpiece.
2. Lock the router.
3. Wind down the depth stop foot onto the router base. This has 'zeroed' the bit using the depth stop.
4. Now lift the depth stop foot the amount needed, using the depth scale or;

If you are depthing the router to the depth of the marker board, you can put the actual board between the router base and the depth stop and bring the stop down onto the board. Tighten. Take out the board, (see illustration). Now when you plunge the router the bit will be a board thickness deep.

Trouble: The Depth of Cut

When some routers are fully depthed, the nose of the collet does not project below the Base Plate, so you lose part of the depth of cut with a small cutter. When you use some kind of extra Base Plate as part of a guide or jig, the problem is compounded. If the shank of the cutter is short, you may not be able fully to depth the cutter without projecting the cutter way out from the collet. This tends to get very unsafe. And even if the cutter shank is long enough, it is still left flexing and unsupported. You can gain a little depth by taking off your router's plastic face plate, but this is hardly adequate.

This is a serious problem. If you do not have enough depth, the cutter is useless. 1/4" routers sometimes have adequate depthing, but the larger routers rarely do. Neither do their makers tell you how to solve this problem.

What to do?

We find that when using 1/2" routers, it's easier to keep the 1/2" collet for all cutters and use a 1/2" to 1/4" sleeve to change the shank diameter of the 1/4" cutters, instead of dismantling the collet each time you go from 1/2" to 1/4" bit and back again. Project the sleeve a little from the collet and project the bit a little from the sleeve, to give bits with short shanks greater depth.

This largely overcomes the problem. It also protects a long shanked cutter by supporting the shank. If you are using 8mm shank bits, it is just as easy to use a 1/2" to 8mm sleeve. You can use the two together without changing the collet. 8mm shanks have the advantage of a firmer shaft and are used extensively in Europe.

The use of the sleeve for long runs is not recommended by some router makers and suppliers because it puts strain on the bearings of the router. Our experience is that we have used the sleeve for many hours work, in the gentler conditions of the WoodRat, without any problem.

Gauging Pieces

You can also make up small gauging pieces of hardwood of known thickness, or small strips of acrylic (perspex/plexiglass) to give you the depth of a groove, say – or the depth of sliding dovetail joint etc. They'll be useful later.

Section 3

Profiles & Grooves

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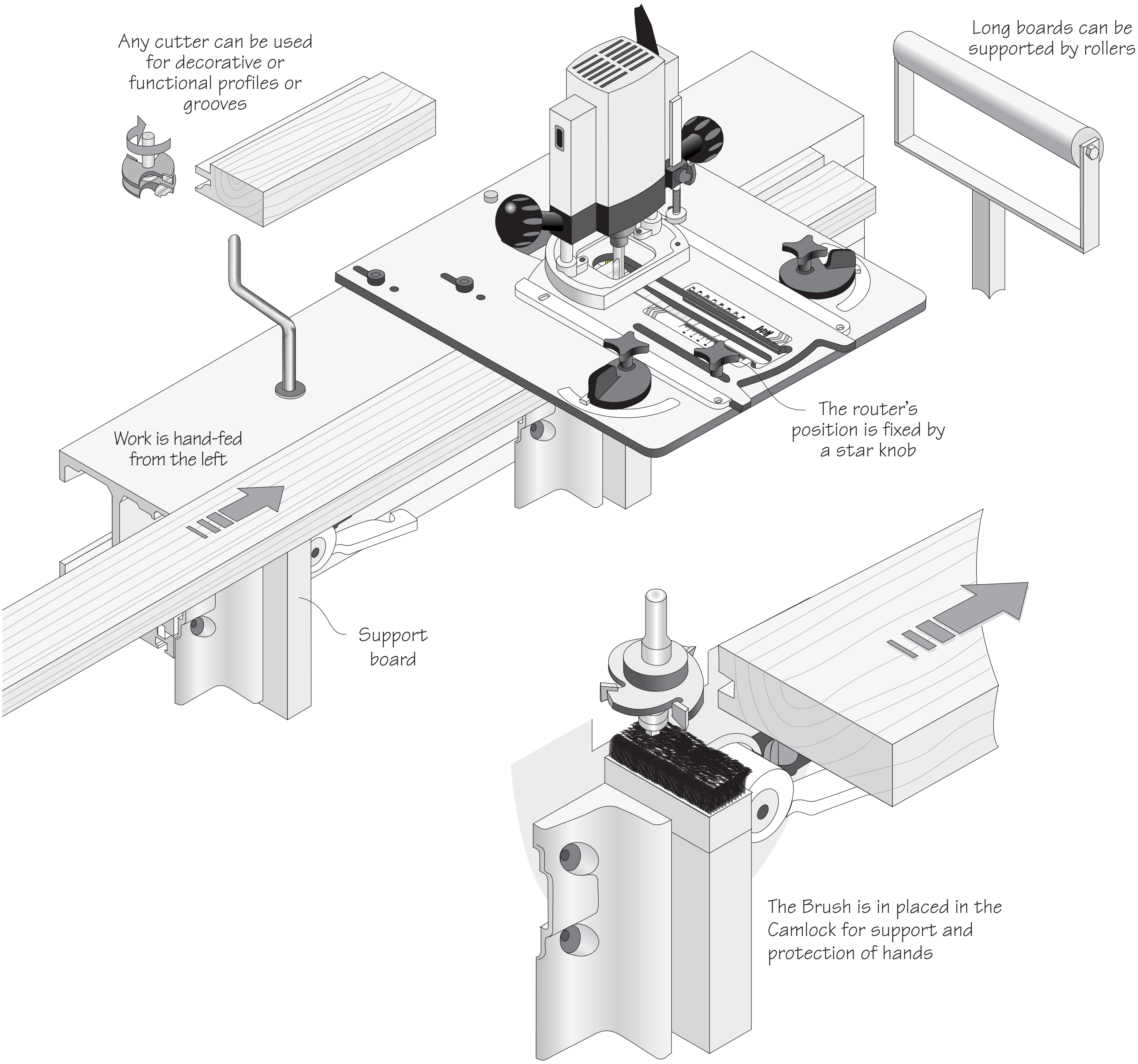
Handfeeding profiles and grooves



Any cutter can be used for decorative or functional profiles or grooves

Long boards can be supported by rollers

Work is hand-fed from the left

The router's position is fixed by a star knob

Support board

The Brush is in placed in the Camlock for support and protection of hands

Hand Feeding

When the cutter is depthed below the Plate, work can be passed through, just as one passes work across a router table. The difference is that the router is the right way up so you can get to the controls and depth the router easily. The depth of cut is constant as with a router table, but you can see the cutter as it cuts, as with an overhead router, so you have the best of both worlds.

Below the Plate, the cutter is exposed, so it must be treated with respect. This is quite safe as long as some basic rules are carefully observed.

Set up For Hand Feeding: The Brush

Unlike the Router Table, which has gravity keeping the work in place, The WoodRat uses a simple, but effective alternative – The Brush.

Cammed Beneath the cutter, the Brush forces the workpiece flat up under the Plate, but allows it forward movement without any kickback. It's made from a common household nail brush glued onto a suitable block.

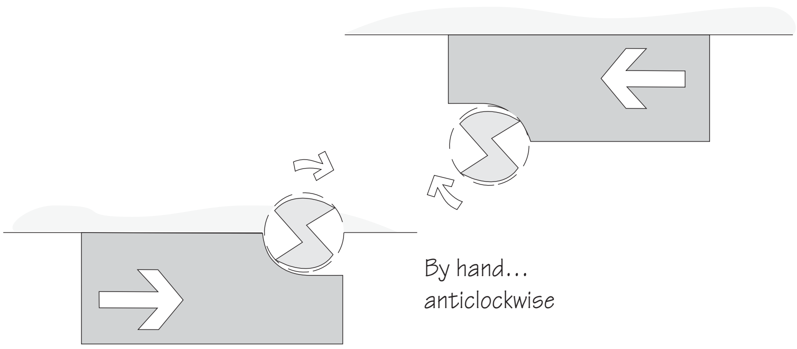
- The Cutter Bock is also used. It is a block of wood supplied with your machine that fits snugly into the cutter opening in the Channel to prevent the work-piece from being drawn into the gap by the cutter.
- Long pieces may need extra support from a block of scrap wood locked in the left-hand Cam Lock.
- Longer pieces need to be supported by rollers placed at a greater distance.

Safety!

The following points should be carefully observed:

- It must be said, even though it sounds obvious: *do not let your fingers follow the wood into the cutter.* When your mind wanders as you are doing the hundredth piece, or the phone rings, it's all too easy. Place the Brush so that your fingers cannot follow into the bit as you feed in the stock.
- Never feed the wood with your fingers directly beneath the path of the cutter either, for another reason. It's possible for the cutter to work loose and penetrate more deeply than you expect, even winding its way right through the timber as it cuts .
- Place the Cutter Block to prevent the wood from falling into the cutter gap, especially when working small pieces.
- Check that the Router Plate is screwed securely to the Base Plate with the Star Knob. It is all too easy to forget this and find the bit wandering in the cut.
- When cutting very small pieces, do not hand-feed. Devise a carriage that can be held in one or both Cam Locks and track it through the bit. Very small and tricky odd shaped pieces can be held in a Sugar Tong vice or the Mitre Box.
- Get the direction right!

Feed Direction



By holding the router fixed, the workpiece can be moved into the path of the cutter. The cutter is usually going down the length of the grain.

When hand-feeding stock, you pass the wood against the spin of the blades. If you go the 'wrong' way, the cutter will grab the wood and fling it across the workshop.

Cutter and wood go round each other counter-clockwise.

Note: *This is true when looking down on the router, as in the WoodRat… the opposite is true when the router is upside down in a router table.*

Try a Profile

1. Place a simple profile cutter.
2. Select a board as a workpiece, about 6" (150mm) wide and over 12" (300mm) long. If it is over 1"(25mm) thick you will not need the cutter block.
3. Fix your Brush in the Cam Lock (in cutter position) to act as a guard block with space for the workpiece to pass between its bristles and the Plate. The work is held up by the bristles yet can slide easily to the right.

Tip: Rather than cut the whole depth of the profile in one hit, the cutter can be brought forward progressively toward the final cut.

4. Bring the router forward to project the cutter a little way
5. Fix the Router Plate to the Base Plate with a Star Knob.
6. Hand feed the workpiece from left to right.
7. Bring the router forward to its final position and make a second pass.

Profiles

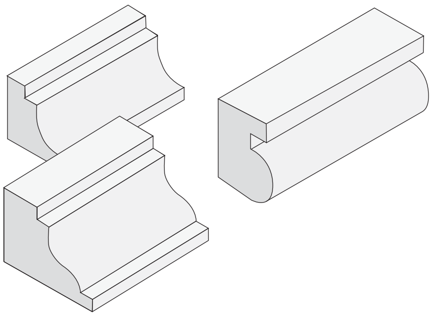
Decorative Profiles

Almost any cutter can be used in the WoodRat to create decorative and functional profiles.

Generally profiles work down the grain, with the wood being fed by hand, but with the WoodRat you can down-cut, holding the stock in the Mitre Box, in the Sugar Tong Vice, the Box, or clamped to the Mortise Rail to take the profile across the end grain as well. There's more on that later.

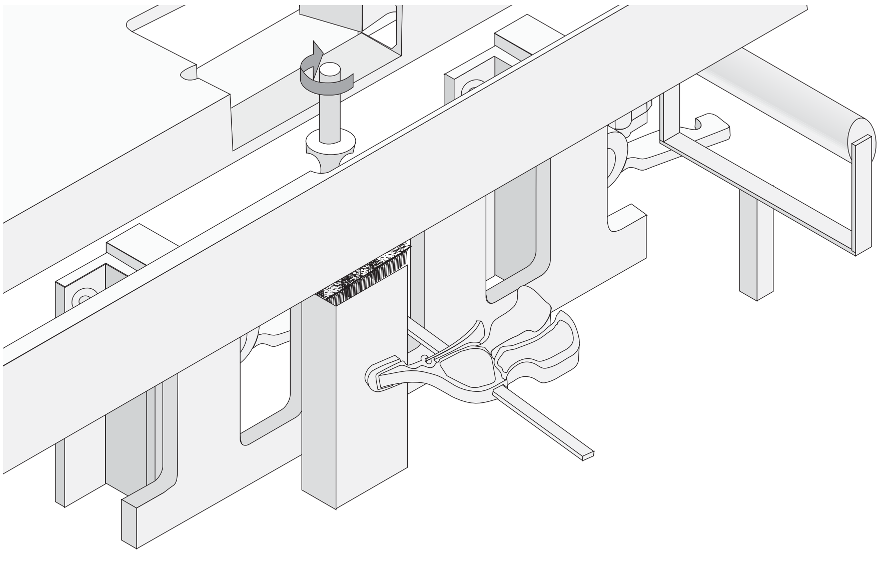
Profiling on the WoodRat is similar to profiling on a spindle moulder or router table. Making profiled strips for decorative effect is best done by moulding the edge of a board, supported by the Brush and cutting it off as a strip when finished.

Decorative Profiles



Mouldings are a pleasure to make, as complex decorative effects can be built up from multiples of quite simple sections. Buying router cutters can be quite addictive and surprisingly complex architecture can be made up with very simple means.

Skirting Boards

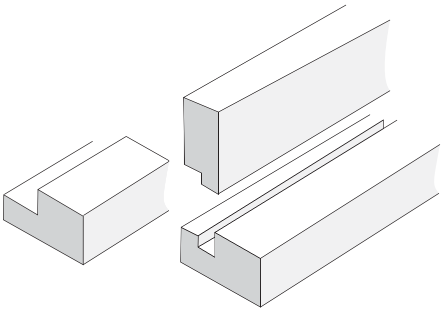


For Skirting Boards and similar profiles, use the Mortise Rail (page 65) and clamp the Brush to it to hold the board flat against the Plate. Rollers can also be added to provide support.

Functional Profiles

Profiles are generally decorative, but a large number can be considered working joints. Here are a few:

Rebates, Rabetts and Rabbits



Rebates is English, Rabetts is American and Rabbits are roughly how they are both pronounced

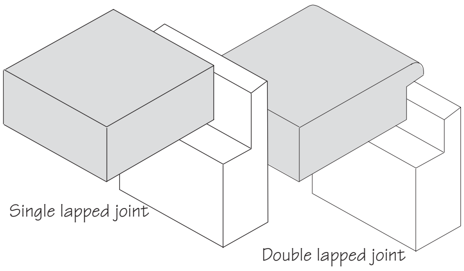
Rebating a board

1. Place a large straight cutter and depth it. Set the cutter at the required distance from the machine face and lock it down with the Star Knob.

2. Pass the board into the cutter on the up-cut. This will make a rebate

3. Again, you can set the cutter to nearly the right depth and width and then make a further pass with the cutter at the correct position.

Lap Joints



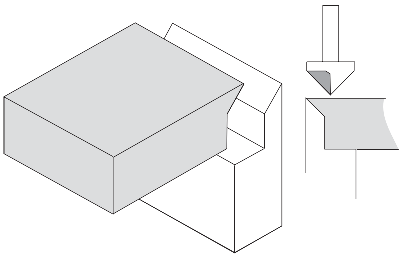
This joint is quickly made and has the merit that the corner can be rounded or chamfered. The double lapped joint has a little greater gluing surface and less of an upstand to get damaged. It will need pins or screws to hold it.

1. Place the first piece vertical and to the WoodRat face.

2. Set the depth of the bit to the thickness of the second piece.

3. Pass the board through on the up-cut.

Mitred Lapped

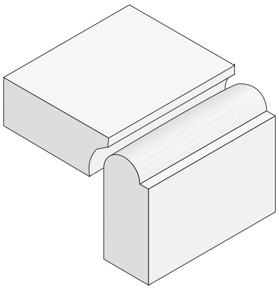


1. Mitre each board first to the same depth, with a mitre bit.

2. Change to a straight bit and rebate one part as before, to the edge of the mitre.

3. Rebate the other piece to the depth of the mitre. Alternatively use the Mitre Box (page 130) for the mitred edge.

Rule Joints



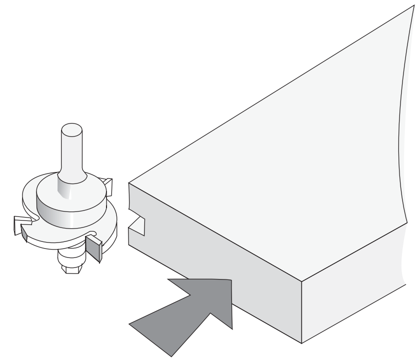
The rule joint is cut with a matched pair of cutters: one ovolo and one cove. They both have the same diameter to the curve. The art lies in placing the hinge in exactly the right place. Here the WoodRat can make a perfect profile, and can also recess the hinges. The WoodRat will also come into its own when making the wooden hinge for the bracket that keeps the table leaf exactly level. This is important as the reflective polished surface gives away any discrepancy in levelness between the fixed and the folding surfaces.

Slots in Edges

Use a Slotting Cutter or matched T, V and G cutters to cut the edges of a board to join boards for table tops and flooring. You simply profile the edges.

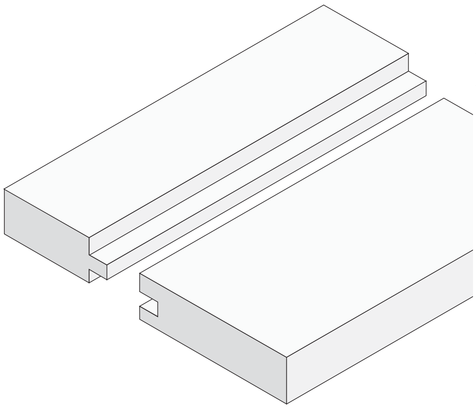
Place The Brush to support the workpiece.

Spline Joints & Tongue and Groove



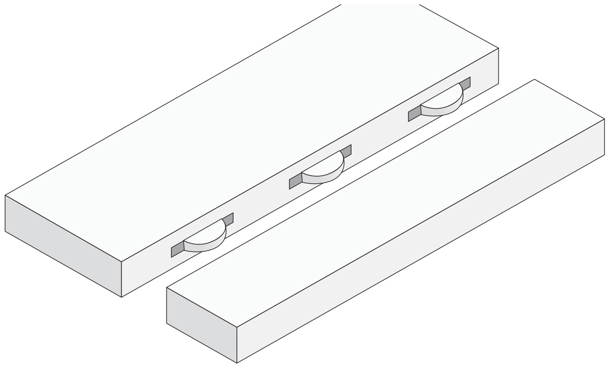
A spline joint is stronger than the tongue and groove joint because you can make the spline from cross grain wood, or ply.

If movement is expected, the spline can be loose, with the boards held together by other means.



Matched profile cutters give elegant tongue and groove boarding.

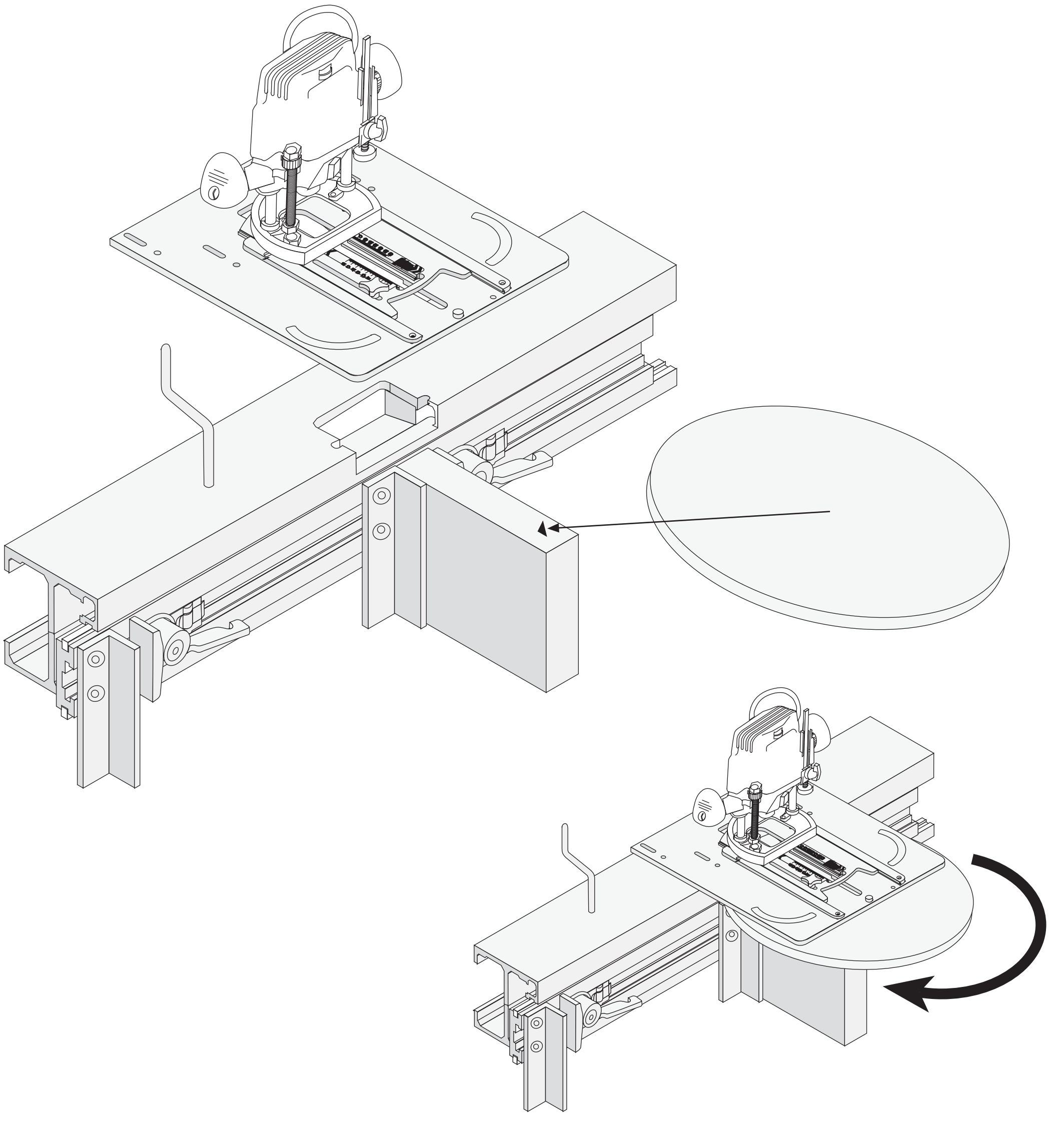
Biscuit Joints



Instead of a continuous groove, the spline can be replaced by biscuits and the groove by a series of short grooves. Use the Brush to hold the work against the underside of the Plate as you push the work against the cutter - so that the position of each slot will be constant.

Routing Circles

Circular table tops etc, without using a lathe



1. A scrap board with a sharp steel pin embedded in the top is cammed in Cutter Position. The roughly cut table top is placed centrally on the pin.

2. The board is brought upward against the workpiece, embedding the pin to form a pivot point around which the board can spin. The whole arrangement is pushed up under the Plate, and tracked to be central to the router. Any movement is taken out of the supporting board, as it is cammed in to place.

3. Now the board can spin, with some friction, under the Base Plate.

You might need a moulding cutter for the edge of the table: Hold the table top to stop it spinning as you plunge the cutter.

Important: *Take several passes to reach full depth. Take it gently to avoid the danger of the bit spinning the workpiece.*

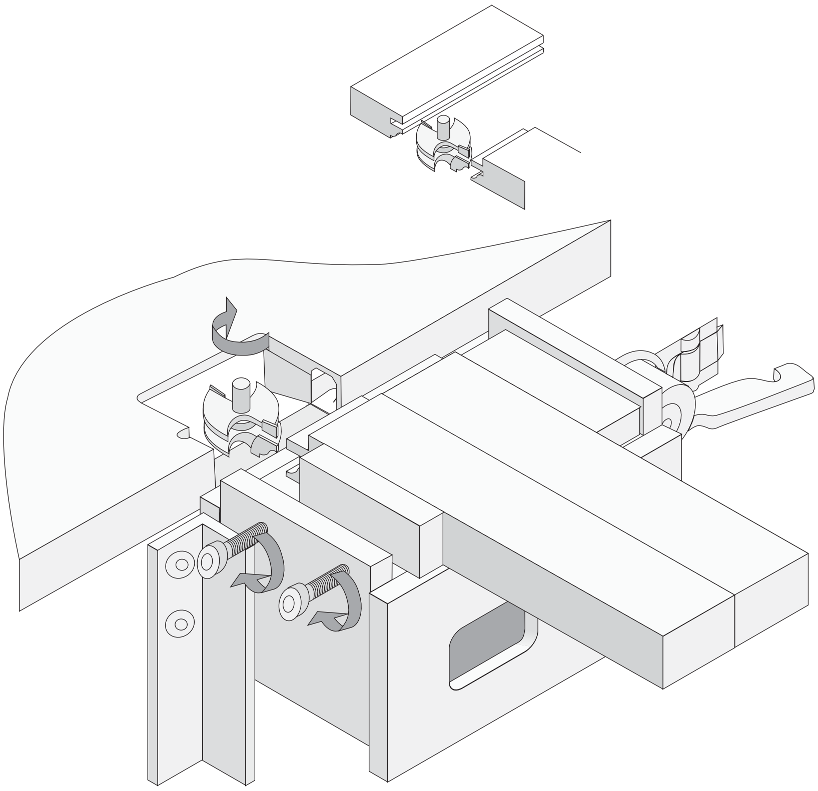
You might want to run a shallow groove or form a recess for inlay around inside the edge. Use a Spiral Down Cut if you have one, to avoid tearout.

Profiling Across Board Ends

Most of the work up to now has been by passing the work by hand through the bit, down the grain.

Profiling the ends of rails needs a different approach. The rails will need to be held as they are passed through the bit. There are several ways to hold the pieces.

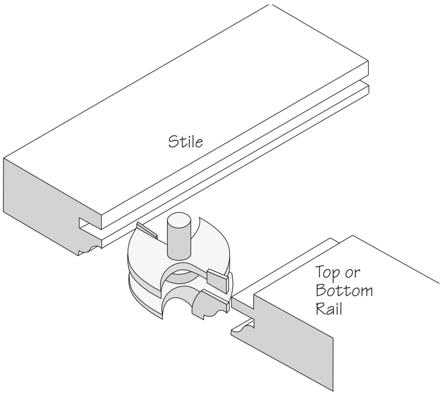
Set-up 1 - The Box



The Box is a jig you make yourself, (see page 131) out of MDF or plywood. It acts as a platform that is held in the Cam Lock, onto which pieces can be clamped and cut at the same time. Workpieces are held in place with cap-head screws screwed into threaded inserts with packing pieces to prevent marking the wood.

Work can also be glued onto the Plate with a glue gun which works well.

Profile Scribing (Cope & Stick) Cutters



Profile Scribing cutters are a modern alternative to the traditional mortise and tenon for making cupboard doors. They rely on a tight fit and good glue.

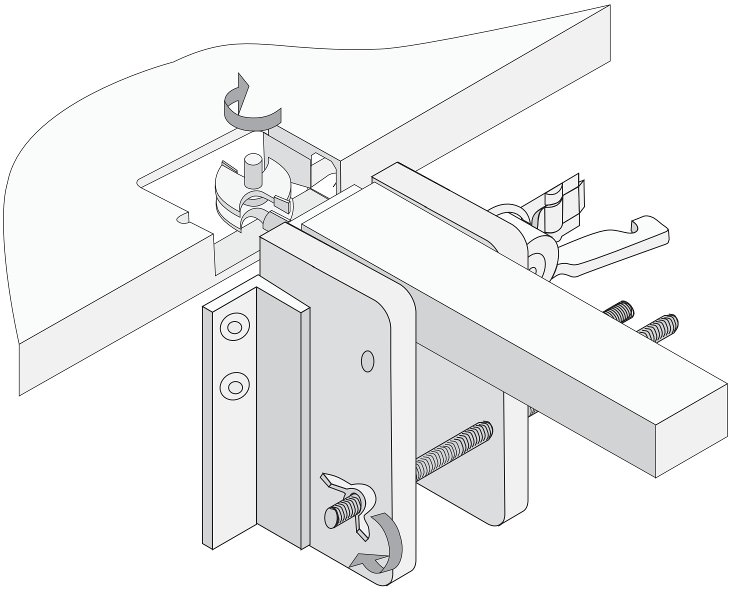
1. Place the top and bottom rails in the Box and profile all the ends. You have the advantage of being able to down-cut to avoid tearout.

2. You then rearrange the cutter, replace it and take out the Box. Now you can profile the two stiles. Their edge profile will match the scribed profile of the ends

3. Finish by profiling the edges of the top and bottom rails.

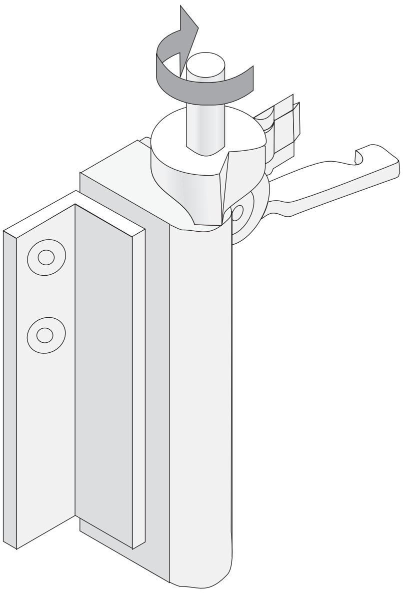
To make a door panel see page 39.

Set-up 2 - The Mitre Box



A WoodRat accessory, the Mitre Box can hold wood at any angle from 0 to 90 degrees to the cutter. It fits into the sliding bar and is held either side by the Cam Lock.

Pin Routing



Pin Routing is usually done with the pin above the router. Here, with the router the right way up, the pin is below.

It consists of a rounded board cammed in Cutter Position, arranged so that the rounded end of the board contacts the template below the work and allows the cutter to shape the workpiece.

This will give the arched shape to cupboard doors.

The easy arrangement of pin and cutter mean that you can round square sections with an ovolo cutter for chair parts. You do not need a bearing with the cutter.

Raising Panels

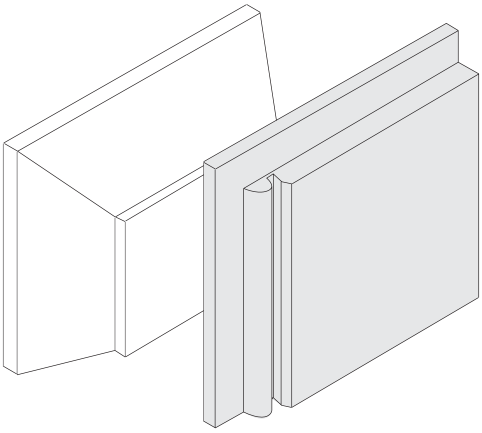
Panels are profiled in one of two ways:

Horizontal

The panel is placed horizontally and flat and cut with a dish shaped cutter. The cut is predominantly horizontal. This means that the tips of the bit could be travelling at a speed of well in excess of 100 mph. **A router with controllable speed is therefore essential - slow it down to 8,000 rpm.**

This is fine, as long as the pass is well protected and the workpiece well supported. The greatest diameter of cutter usable in the WoodRat is 86mm wide. However this will not give a very wide band of fielding on a panel, particularly as 10mm is lost in the door frame. Feeding by hand also gives tearout along the shoulder of the fielding.

Vertical



It may be better to use a vertical cutter and place the stock upright. This will give a profiled depth of 50mm or more, which is the equivalent of more than a 100mm horizontal cutter!

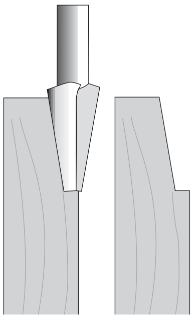
• It is possible to depth the cutter to 50mm (2”) so you get a generous fielded border, which does not look skimpy on a large panel.

• You can gain further flexibility by having the cutter vertical, yet with the board held at an angle. This means that a straight panel cutter cuts an angled cut, fielding the panel.

• And, you can further change that angle, giving a more or less strongly fielded panel.

• If you down-cut with a razor sharp bit, it will give a clean cut to the raised edge. If you go back on the up-cut you will get a near perfect finish to the fielding.

Using a Cone Shaped Bit.



Cone-shaped bits are either straight or shaped. They are usually TCT.

Set up: Work less than 12” (300mm) long can be simply cammed in the Cam Lock.

For work over 12” up to 30” (300-750mm) take off the right hand Fixed Fence.

Place one or two Raising Plates, as necessary.

1. Simply Lock the panel into place and run it past the bit. Start with a cut across the grain.

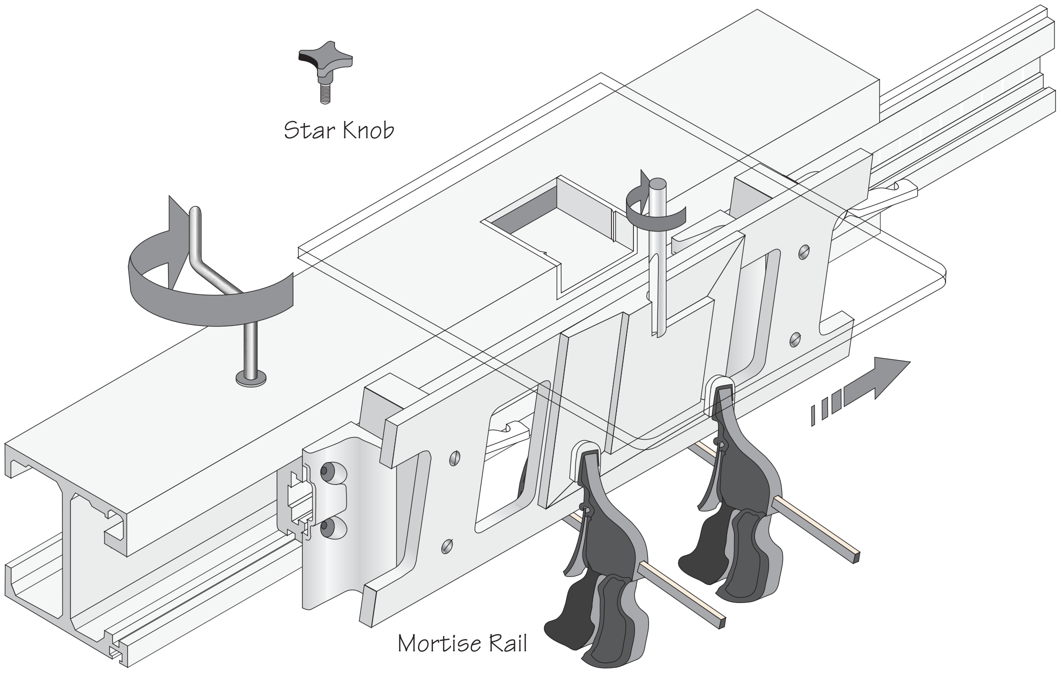
2. Pass the panel from left to right with the cutter in front of the panel. Run the panel back on the up-cut, to clean the face of the fielded area. Cartwheel the panel between each cut.

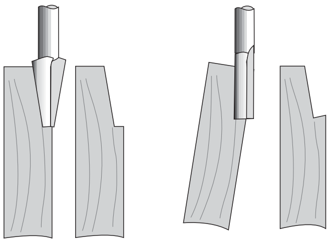
Depending on the depth of the fielding, it may necessitate one or two passes. In which case leave the final depthing for the final cut.

3. Mark up the Guide Rail with the exact position of the final cut. The edge of the panel needs to end up the right fit for the groove, leaving enough room for moisture movement.

Raising and Fielding Large Panels with the Mortise Rail

Set-up





Straight or cone-shaped bit

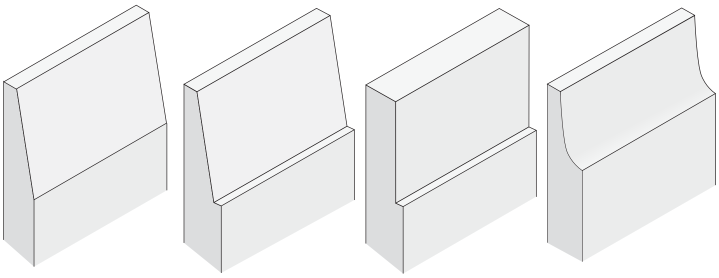
Place the work on the Mortise Rail. Use a straight panel cutter and angle the panel forward.

Instructions on how to build a Mortise Rail can be found on page 65.

Tip: If a panel is too thick to fit the groove, you can straighten the Mortise Rail and rebate the back side of the panel so that it will fit.

Mulleting

Mulleting is bevelling a panel to fit as a drawer bottom or for a door.



It is traditionally done with a plane as a shallow chamfer, but is quickly made on the WoodRat. The panel is locked in place in the Cam Lock, and run past the bit. The bit can be a straight bit or conical, with or without a curve.

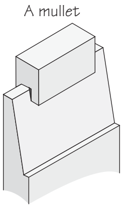
Small Panels:

Place small panels in the Cam Lock and run them past the bit. Either out cut or in cut, observing the down-cutting technique.

Larger panels:

Place the Mortise Rail. The Mortise Rail can be vertical or slightly angled

The Mullet



The Mullet is a block of wood grooved by the cutter that cut the groove for the panel. This is used to test the thickness of the panel. It was more useful when this thicknessing was done by hand, but it still makes a useful check for fit.

Grooving

Cutting grooves is such a quick and easy operation on the WoodRat that it's not necessary to reset other machinery to groove the sides of a drawer or a box after cutting the dovetails. Besides, there are things that the WoodRat can do that the saw-bench cannot.

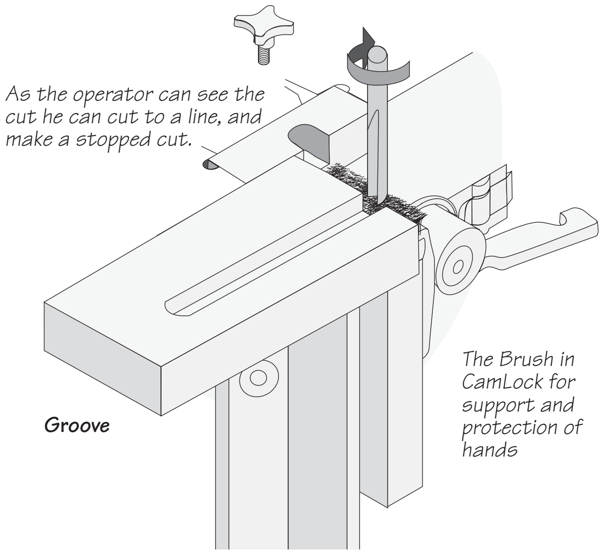
Set-up

Guide Rails in place or if you are dovetailing, you can leave the Centre Plate in place.

Star Knob to fix Router Plate

Support for workpiece - the Brush

Cutter Block in place

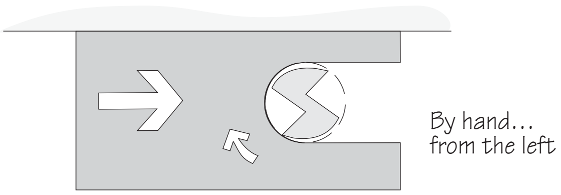

As the operator can see the cut he can cut to a line, and make a stopped cut.
Groove
The Brush in CamLock for support and protection of hands

Grooves can be ploughed for lids and drawer bottoms. Shallow grooves prepare for inlay and stringing, and the finest cutters will give grooves for white lining. Pieces can be simply fed under the Base Plate into the fixed cutter bit.

Important: *Don't omit the Cutter Block or the board may swerve into the gap and the groove will be spoiled.*

Safety - Direction of Cut

When cutting a groove in a board always feed from the left. The cutter will pull the work against the machine face.

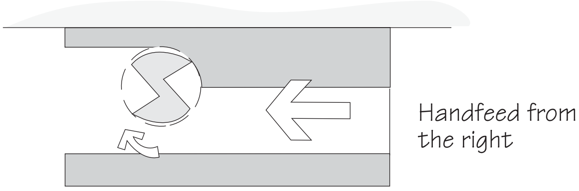


If you go the wrong way, the bit will tend to roll the piece as it cuts, away from the face, giving a bad cut.

Widening a Groove

Having made one grooving cut, be extremely careful when widening it. The next cut must be an up-cut, (against the cutter blade). The bit goes clockwise, but the direction of the pass will depend on which side of the trench is being widened.

If you were to push the router north by 1/8" (2mm), to make a wider trench and fed the board again from the left, the cutter would grab the board and "roll" it, taking it through at speed, possibly flinging the board across the room. So, in this instance, feed from the **right hand** side.



Therefore, when holding a piece and feeding it through the bit, never hold it in such a way that if the piece were to be whisked away by the bit, the hands would be exposed to the blades.

Try a Groove

1. Place a straight cutter.
2. Bring the router forward about 15mm from the Machine Face and fix it to the Base Plate with the Star Knob. Zero the cutter. Set the depth stop a little.
3. Depth the bit a little.
4. Place 'The Brush' under the cutter below the Base Plate with room for your stock as before.
5. Plunge the bit and feed the wood from the left.

Stopped Slots

The WoodRat's advantage is that the cut can be stopped so that the groove does not run through the joint to the outside of the piece and look unsightly. If the brush is giving the correct pressure, a groove can be started or stopped anywhere along its travel. The technique is to have enough upward push from the Brush, so that the cutter will not make the wood wander as it starts its cut, yet not so much that you cannot move the workpiece.

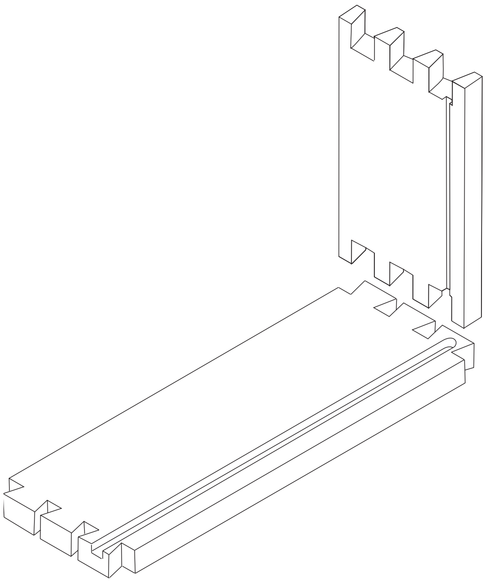
If you have a router with a PlungeBar, place the Brush firmly, so there will be no movement of the workpiece when you plunge the cutter.

1. Track the piece to the start point.
2. Check the position with the router off, switch on, and plunge the bit.
3. Pass the work through, until the end point of the slot. Un-plunge the router, and there it is.

Grooves in a Dovetailed Box or a Drawer

Having made a ring of dovetails, it's very quick to finish them with the groove for the bottom or lid.

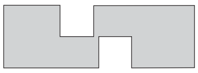
1. Place a straight bit and depth it to about one third of the thickness of the box side.
2. Make sure that the bottom edges of the ring are flush, each board level with its neighbour. Otherwise the grooves which run round in a ring will joggle because the groove position is set from the edge.
3. Place the Star Knob.
4. Set the cutter at the correct distance from the bottom edge and tighten the Star Knob.
5. Use the same setting to groove the drawer slips and the central muntin if you have them.



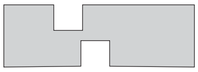
The drawing shows the groove in a box bottom . The box end is not a problem as the groove runs through between the pins. In the side the groove goes right through the tail and shows as a square hole on the outside of the ring. At the other end, the cut is shown stopped, so that it does not appear on the outside of the ring.

When grooving for drawer bottoms this is not a problem in the traditional drawer, as the grooves are placed to go through the bottom socket of the drawer front, where they are hidden by the Lap.

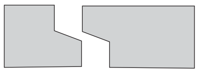
Rebating and Grooving Box Lids



A groove from each side almost parts the board. If the cuts are not opposite eachother the top of the box willl fit into the bottom.



If the cuts do not depth half way the lap can be made to wedge one part together with the other.

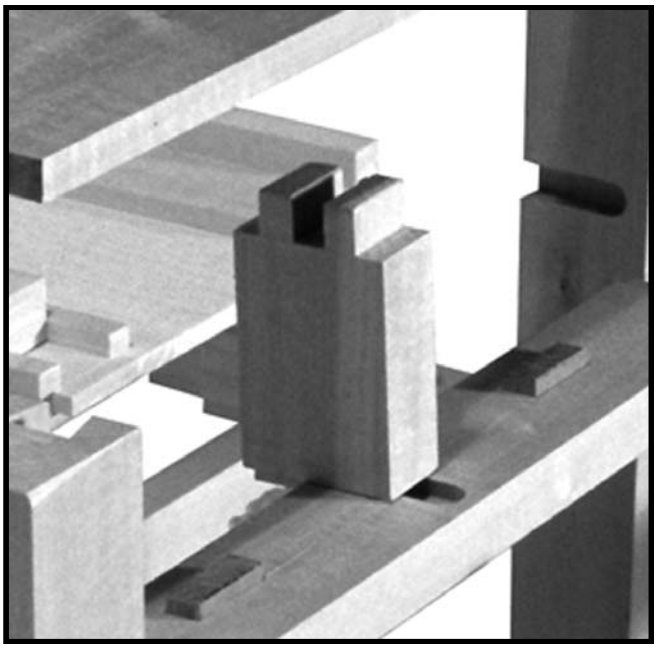


You can also develop techniques for cutting off lids of boxes by cutting half way through on one side of the piece, and then turning over to cut half way though the other side

If the second cut is slightly offset, the board will be almost cut through. The pieces can be parted with a knife, and cleaned up so that the lid of the box ring will fit into the ring of the bottom part of the box.

This is an extremely useful technique as it is quite easy to do, and a box lid that fits snugly will make the box resistant to moisture and insects.

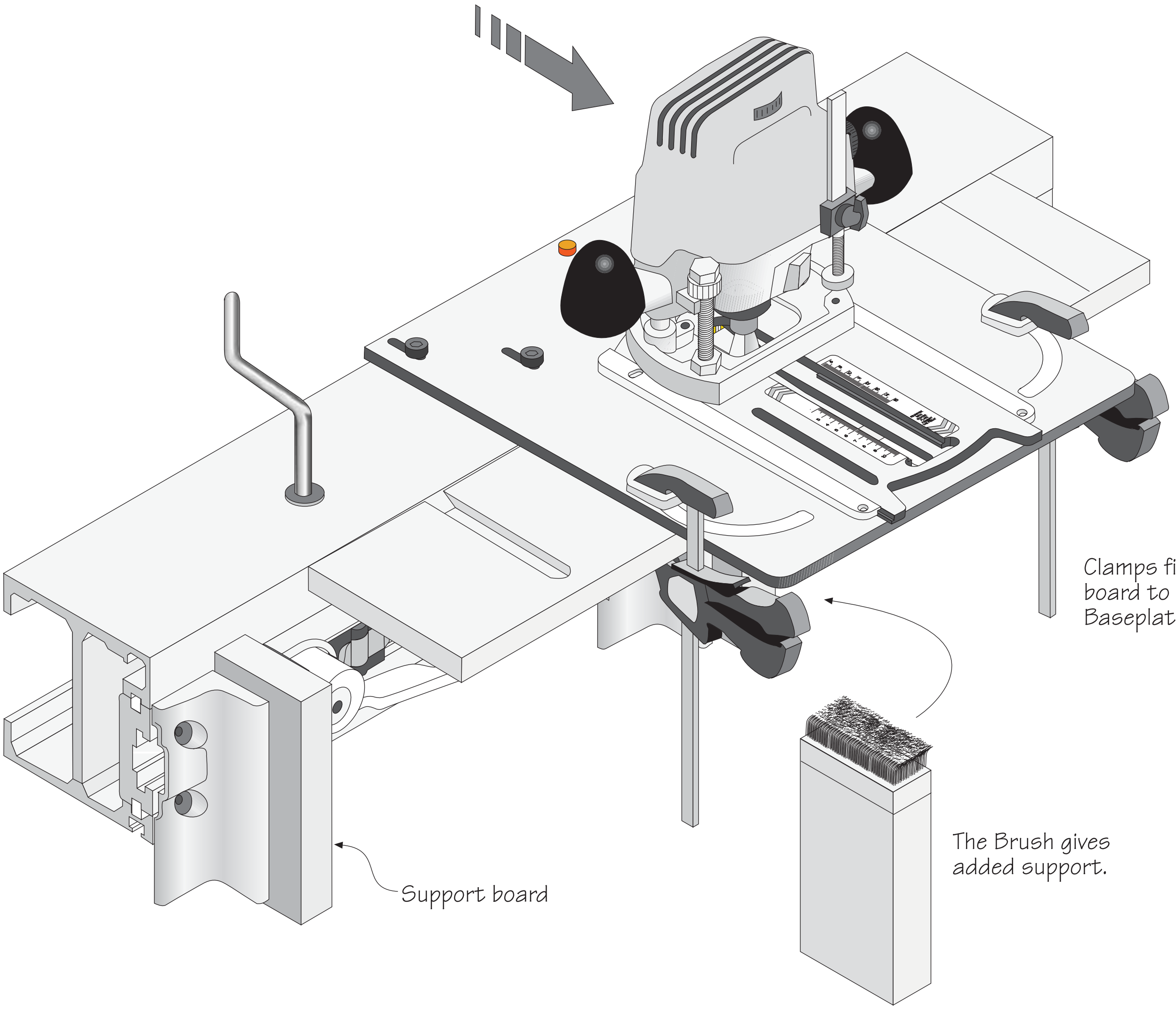
Section 4



Trenching

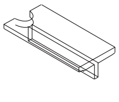
Housing Joints and Sliding Dovetails Part 1 **48**
Halving Joints **49**

Trenching for Dado/Housing Joints or Sliding Dovetails



Clamps fix the board to the Baseplate.

The Brush gives added support.



Use the Centre Liner to line up the cutter with a pencil line

Trenching

For Sliding Dovetail mortises, Housing (Dado) Joint mortises and Dowel Joints. The work is placed flat, across the machine and fixed, you can bring the router forward to make a trench. You can also fix the router at any position and plunge the cutter to drill holes. The cut can be a single cut or it can be widened.

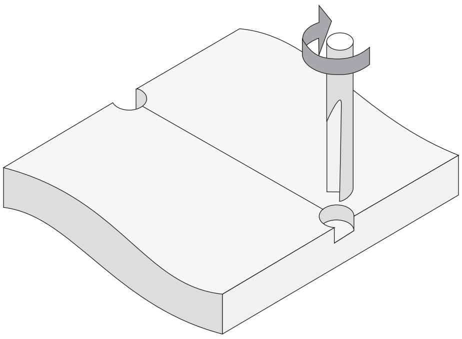
Set-up

- Place the Guide Rails
- Place the Brush up under the Base Plate, leaving a gap for the workpiece.
- Push your workpiece between the Base Plate and the Brush. Hold it loosely with a pair of clamps.
- Carefully locate the rail or board using the Centre Liner and tighten the clamps.
- Zero the cutter, depth and plunge.
- Cut a dado, housing or groove, either straight sided or dovetailed, parallel sided or tapered

Warning - *The cutter is coming down the central slot in the Base Plate. Make sure that it will not cut the Plate at the end. Also, do not use a cutter larger than 1/2" (13mm) or you will cut the slot.*

Extra Base Plates can be adapted for wider cutters and can be obtained from your supplier.

Avoiding Tearout



Tearout in a trench happens when the cutter enters and exits the board.

To avoid it, simply plunge the bit to its set depth at both ends of the line of cut. This will cleanly drill out the wood that would otherwise break out.

Angled Trenches

Cuts can be: Straight, parallel sided or gently tapered with the Guide Rails in place. However, to make an angled but parallel housing. Set up the Plate as you would for dovetailing.

With the Centre Plate, Spirals and Front Stop in place, the forward cut is made with the Router Plate twisted against the left-hand spiral. The cuts can be either through or stopped, but will be limited by the router base hitting the stop block in the Centre Plate.

For longer cuts, bring the Centre Plate forward, and gain extra space by bringing the whole Base Plate forward into First Position.

Place the large Allen key in the stop block on the Centre Plate and fix with a Star Knob to get consistent, stopped cuts (as for Drawer-Front Dovetails).

Housing Joints & Sliding Dovetails Part 1

This section deals solely with the housing parts of these joints. The tenons and the methods for making them fit are discussed in the next section on Tenoning. (page 56).

The Housing

1. Place a Brush under the Base Plate. Push the work between the Brush and the Base Plate. Now the workpiece can be moved left and right to position it exactly, and then be clamped to the Base Plate with a pair of soft nosed clamps. (QuickClamps or Klemmsia clamps are ideal). If the plank is long, place a second spare board in the left Lock for extra support. If it is very long, add rollers.
2. Place the two Guide Rails (remove Centre Plate and Front Stop). Now you can bring the router right forward to the front of the Plate. If you need the extra inch, slacken the Base Plate Caphead screws and bring the Plate forward into First Position, (see page 14). The maximum travel is now 10” so you will need to make a stopped cut if your shelves are wider than that. Be careful not to cut the front of the Base Plate.
3. Mark out the board with a single pencil line marking the centre of the joint.
4. Carefully place the board under the Plate and line up the pencil line with the Centre Liner.
5. Fix the board in position with the clamps
6. Depth the cutter (perhaps using an acrylic strip to give a known and repeatable depth).

   Bring the bit forward through the workpiece as a Housing/Dado cut or a Sliding Dovetail. Stop the cut at a known mark, if you need a Stopped Housing.

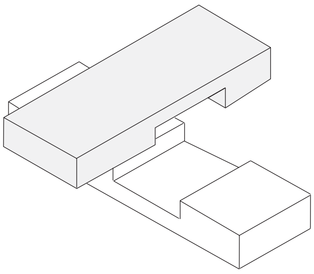
   This makes the female component.

Halving Joints

Frames, screens and grating are made with halving joints. There are two basic ways of making them;

- Cutting the joint to the width of the finished workpiece
- Cutting the joint first in a plank and then slitting the wood to to the width of the joint

Cross Halving Joints

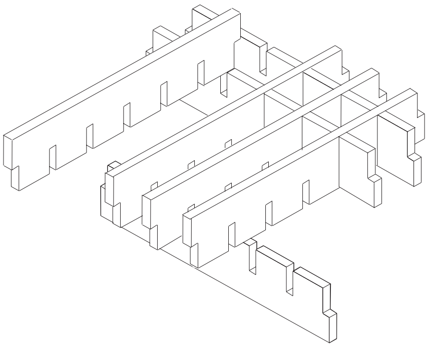


- Use the Brush to keep the rail up under the Plate.
- Clamp the rail to the Base Plate.
- Use the Guide Rails.

Because of the likelihood of tearout along the trench, the halving joint is best made with a spiral down cutting bit, but it is not essential. Tearout can be eliminated by plunging the cut at the entering and leaving edges of the rail.

In a cross halving joint the width of the cut-out in one piece equals the width of the other member. The depth of the joint is normally half the rail thickness.

Egg Crate Construction



It is usual to make the joint width to fit the rail width, but for small stuff with a lot of cross members it could be better to make the members fit the joint Thus:

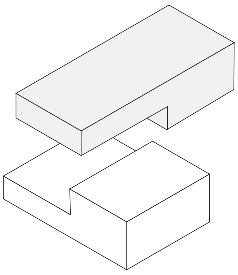
1. First cut the joint by cutting across a board with the bit, cutting exactly half way through it.

2. Now slice the board in strips, and plane each slice to the exact width of the cut of the groove.

The parts will interlock perfectly.

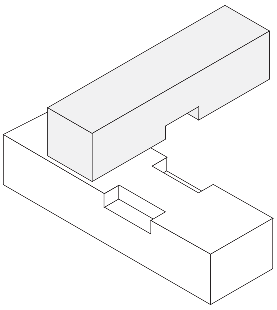
Halving Joint Variants

Corner Halving Joints…



…are easily made but have no lock, so it's only a little more work to make a bridle joint that has - it's always best if your project does not fall apart as you work on it.

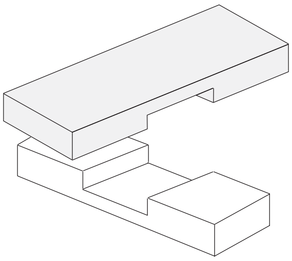
Cogged Halving Joints



This joint is used where the lower member is load bearing. The top member is simply notched, so that it retains most of its strength. Pockets are cut in the lower piece.

When routed, they will have rounded corners that will need to be squared with a chisel.

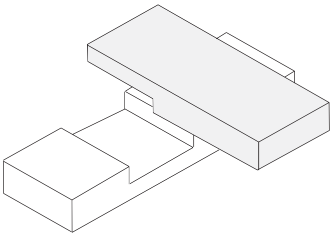
Oblique Halving Joints



The WoodRat has difficulty cutting at angles wider than about 12 degrees. You cannot use the Guide Rails and have to angle the cut with the spirals and the Centre Plate in place as described in the section on dovetailing.

Otherwise you can angle the workpiece by bringing it forward a little and forming a constant angle with a fence clamped up under the Plate. Use the Guide Rails and the Raising Plates if necessary.

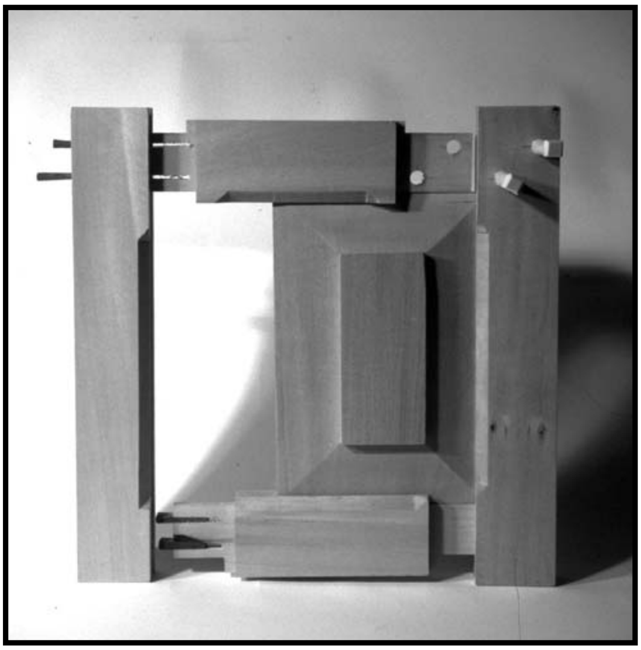
Tee Halving joints



This joint is easy enough, but there is no structure in it, unless it fits tightly.

1. Set the rail clamped up under the Base Plate.

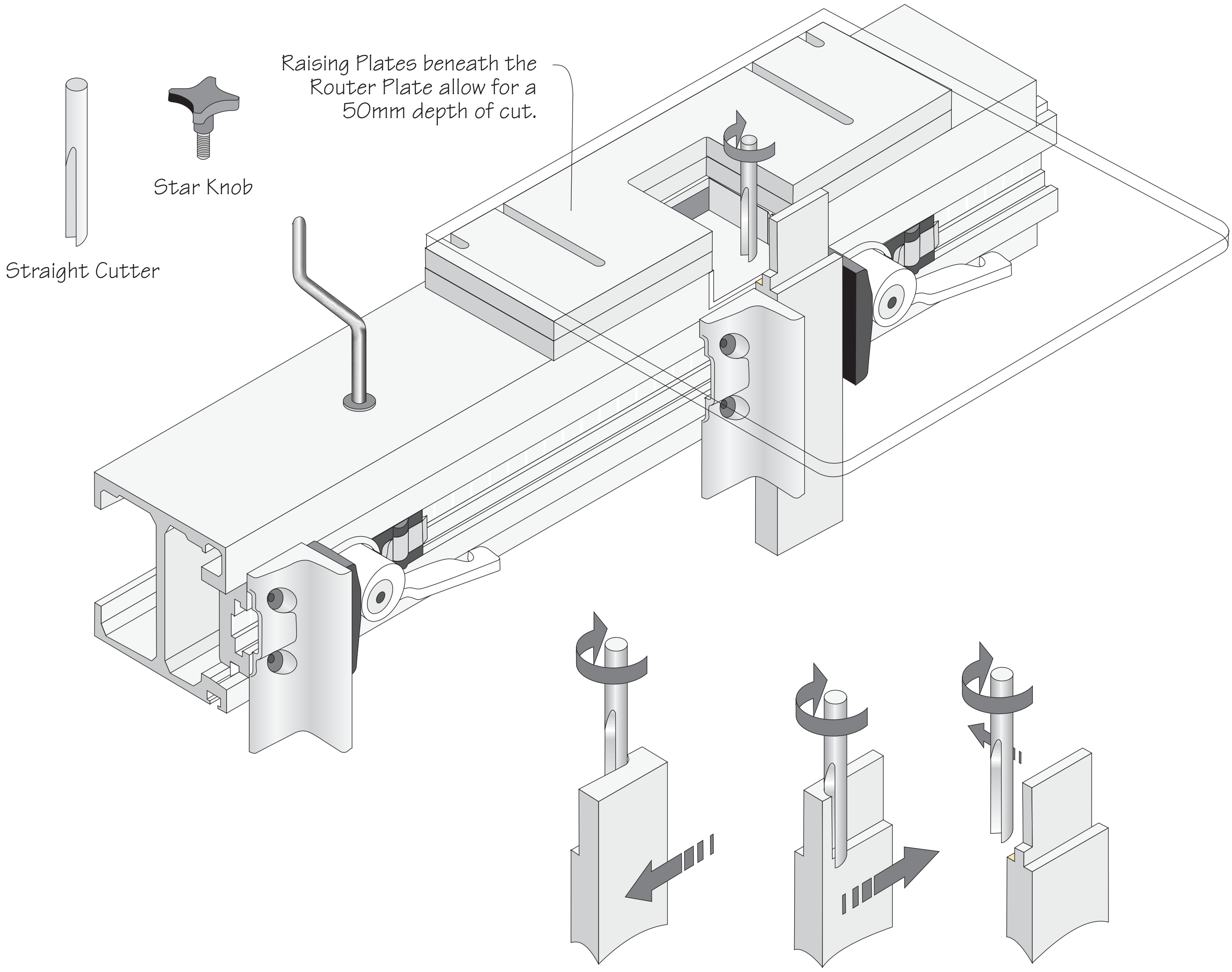
2. Cut the post with a 50mm straight cutter as a tenon, using the Raising Plates to give enough depth for the tenon.



Tenoning

Shelving with Sliding Dovetails 56
Putting a leg on a table with a sliding dovetail 59
Chair Making 61
Bridle Joints 62

Tenoning


Raising Plates beneath the Router Plate allow for a 50mm depth of cut.
Star Knob
Straight Cutter

Tenons

This section deals with shaping the end of a plank or rail. The work is held vertical. It can be a small, large, deep or shallow cut. The end result could be a conventional mortise and tenon joint, a housing joint or sliding dovetail, or laps or tongues.

Set-up

Guide Rails

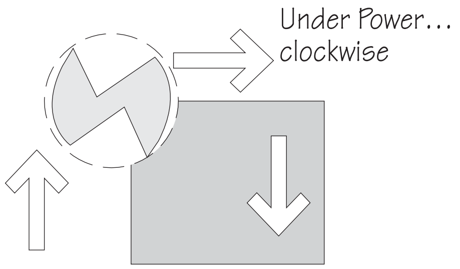
Star Knob

Raising Plates for deep tenons

Straight Cutter

Direction of Cut

We have explained earlier that when the workpiece is held in the Cam Lock and tracked into the fixed cutter, the result is like Power Feeding.



The work can go in against the cutter rotation, as with hand feeding, but it can also go with the cutter rotation – "the wrong way" in other words you can use "climb cutting" or "cut on the down-cut".

The wood, the router and the cutter, can go round each other Clockwise, (viewed, that is, from the top).

This means that you can get a perfectly clean shoulder to the cut and virtually eliminate tearout.

Making a Basic Tenon

There are two basic types: stub tenons (also called blind Tenons) and through tenons

Tenons are made on the WoodRat generally in four simple cuts. There are several ways to position them.

The size of the tenon will be given by the size of the mortise. This can be any size, but usually it will be made by plunging and tracking a straight bit without widening the mortise. The mortise will be as wide as the bit.

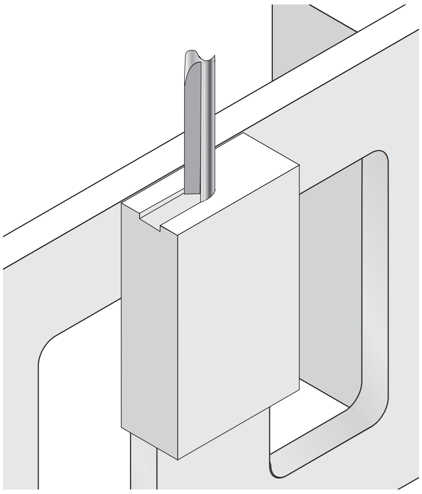
Thus, the tenon will need to be the same width as the bit also.

- Cut a socket in a scrap of acrylic, and that is the width of both the mortise and the tenon.

Setting out:

- You can mark out the work and cut to the line as you would do it by hand. Bring the router, ("off" and un-plunged), over the line to check its position. Then track the work away, plunge to depth, switch on the router and cut.
- Alternatively keep the router plunged and "on". Bring the router forward to the line, and tighten the Star Knob and cut.

Cut your mortises first, and before you take out the Mortise Rail, finish by clamping one rail that will take the tenons, upright on the Mortise Rail, and cut a very shallow mortise in the top of it.



Now, when you come to make a tenon, the shallow cut will give you the exact position of the tenon, as a line would do, but more accurately. This method is developed for cupboard doors (see later).

A third alternative is our preferred way

(Detailed on page 56).

We show first the shallow, long tenons of the sliding dovetail and the housing or dado joint that we made under Trenching… (see page 48)

When you understand the method, you will see that it can be used for deep tenons also.

Either way, depth the bit to give you the depth of tenon needed, and cut on the down-cut – anticlockwise.

All this avoids the need to cut the shoulder line with the marking knife. In practice it may be best to make four preliminary cuts (clock-wise) to cut the clean shoulders, and then cut to the four finishing lines of the tenon.

Sliding Dovetails & Housing Joints. Part 2

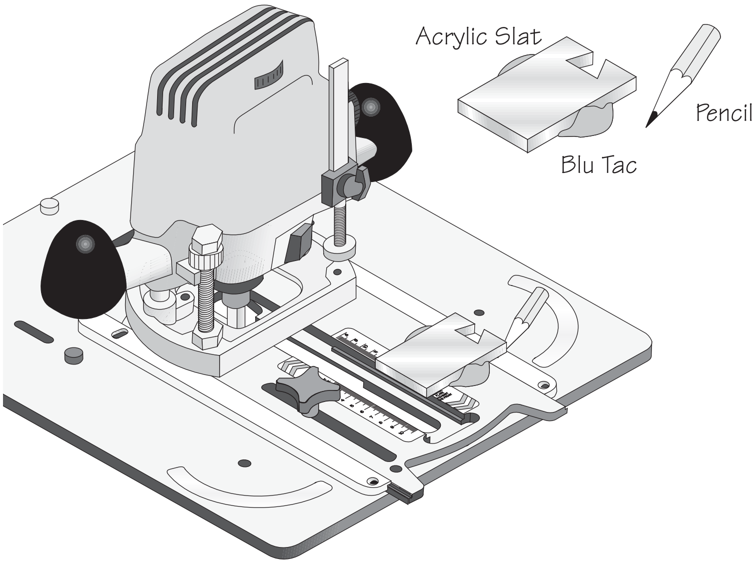
When making sliding tenons the Router Plate is fixed to the Base Plate with the Star Knob and the board is tracked through the bit using the Down-cut technique.

Set-up

Guide Rails | Star Knob | Straight or Dovetail Cutter

Set the same cutter to the same depth as for the mortise. Actually, it's better to make the sliding tenons a whisker less deep, so that the bottom of the tenon will not scrape on the bottom of the mortise when the tenon slides in place: this will bring the shoulders up together and make a nice tight joint

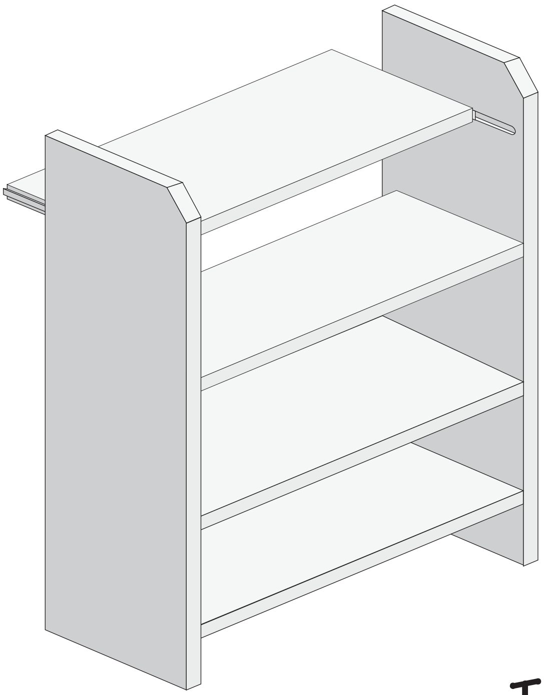
Using a Template on the Router Plate (North/South Registration)

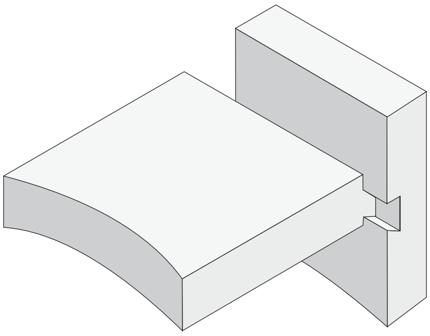


The best way to do this is illustrated here. It shows the first housing cut, and how to position the template on the Router Plate, getting an exact relationship with the template to the marks on the Guide Rail, just as the cutter relates to the wood.

Make a slat, cut with the cutter you are using, and use this to mark up the Guide Rail. A slat of perspex/plexiglass makes the best template for this, although wood will do fine.

Shelving with Sliding Dovetails





Strong and quick to make, the Sliding Dovetail is one of the most important features of the WoodRat system.

This exercise shows how shelves can be made using Sliding Dovetails. It involves both Trenching and Tenoning techniques, so please see the relevant sections on both before attempting this.

The Housing

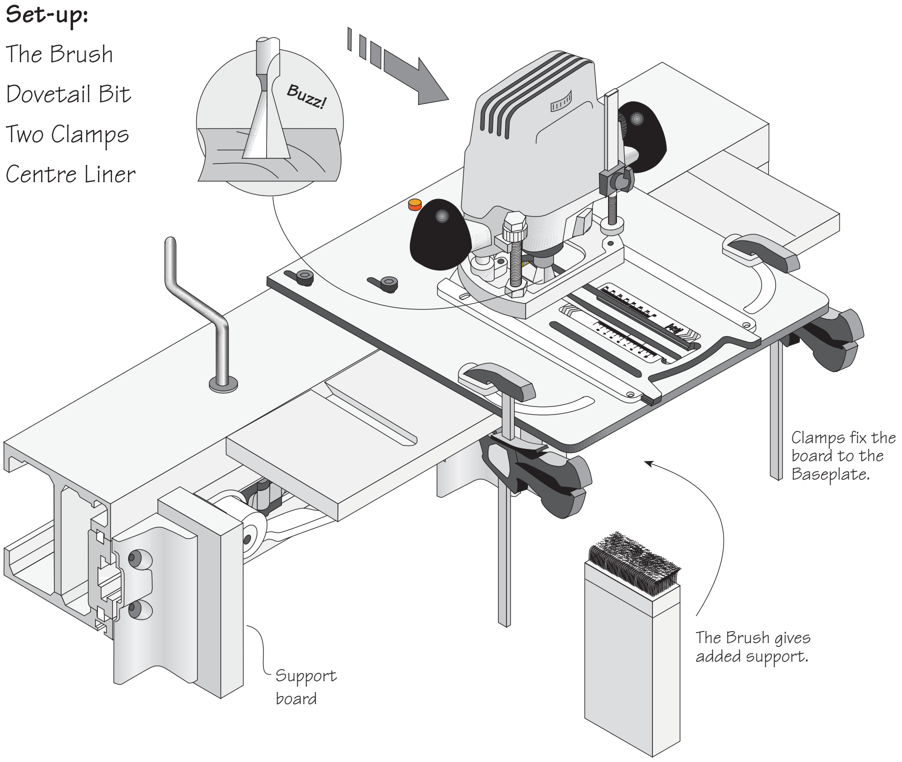
Set-up:

The Brush

Dovetail Bit

Two Clamps

Centre Liner



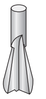
Clamps fix the board to the Baseplate.

Support board

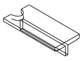
The Brush gives added support.

1. Mark out the board with a single pencil line marking the centre of each joint position.
2. Place the Brush in the Cam Lock. Push the work between the Brush and the Base Plate.
3. Carefully place the board under the Plate and line up the pencil line with the Centre Liner.
4. Fix the board in position with clamps.
5. Depth the cutter (perhaps using an acrylic strip to give a known and repeatable depth).
6. Bring the bit forward through the workpiece. Stop the cut at a known mark, if you wish to hide the joint and avoid breakout.

This makes the housing.

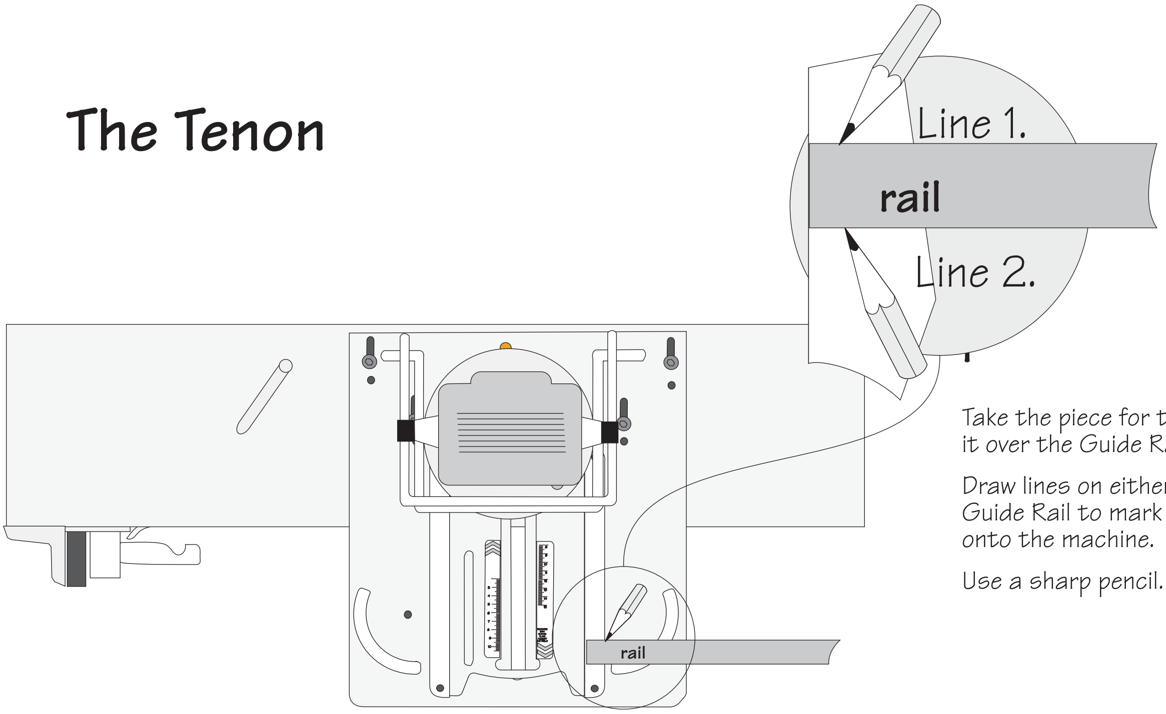


Dovetail bit



Use the Centre Liner to line up the cutter with a pencil line

The Tenon



Take the piece for the shelf and lay it over the Guide Rail.

Draw lines on either side of the Guide Rail to mark its thickness onto the machine.

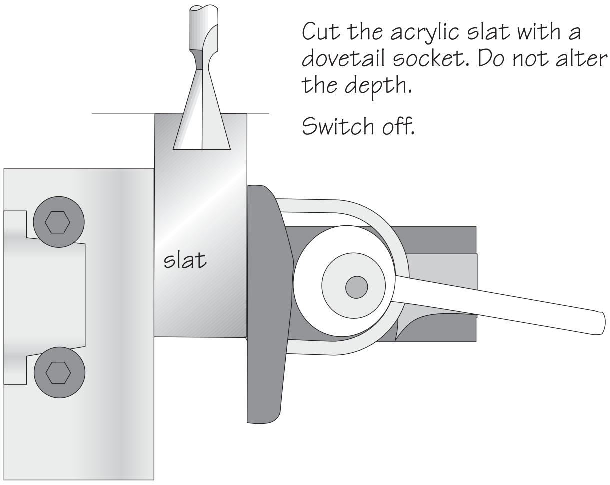
Use a sharp pencil.

2 Place an acrylic slat in the Cam Lock.

Switch on.

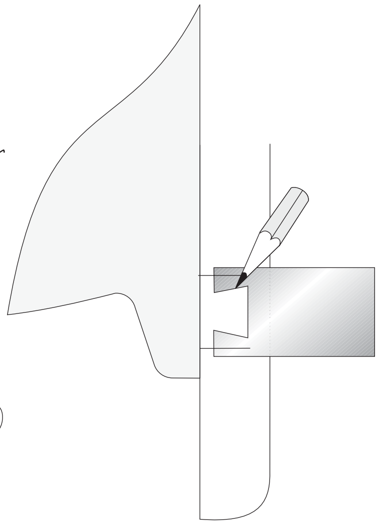
Cut the acrylic slat with a dovetail socket. Do not alter the depth.

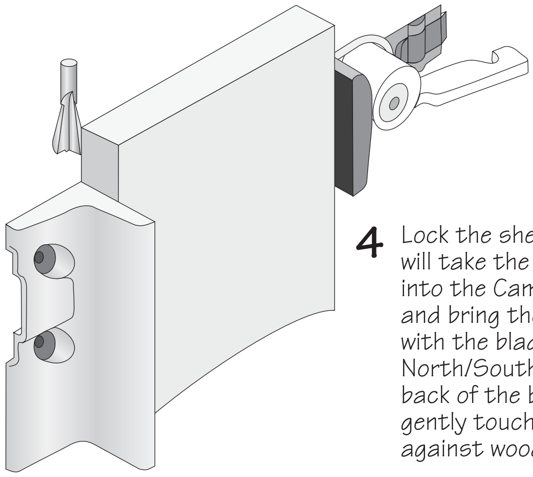
Switch off.



3 Place the Acrylic slat on the Guide Rail and draw the Mark by stencilling-in the socket, central between the first two lines.

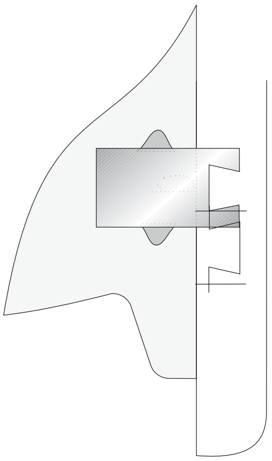
It represents the joint in the shelf end.





4 Lock the shelf, which will take the tenons, into the Cam Lock, and bring the cutter, with the blades North/South to the back of the board, gently touching blade against wood.

That's the real blade against the real wood.



5 Position the acrylic on the Router Plate, with the socket overlapping the Guide Rail, and place it so that the socket (representing the cutter) lies just against the back of the picture of the wood.

Fix the acrylic down with Blu Tac or a loop of sticky tape.

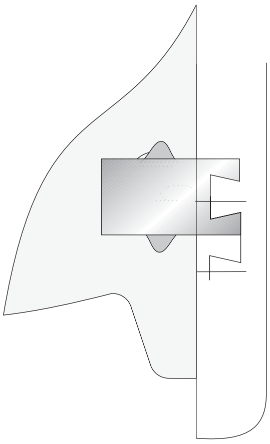
Track the wood to the right, away from the cutter.

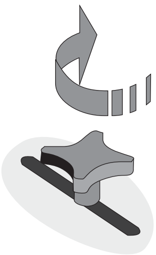
6

Switch on.

Bring the router forward to line the near edge of the socket with the further side of the Mark.

Tighten the Star Knob.





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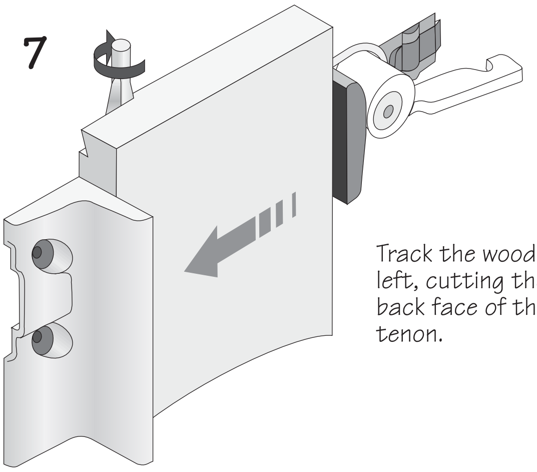
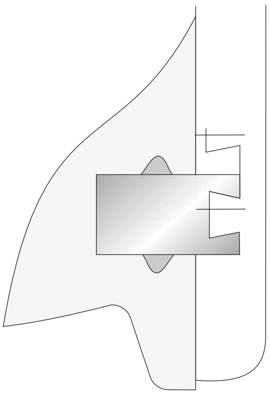


Track the wood left, cutting the back face of the tenon.

8

Bring the router forward and do the same with the socket lined up with the front edge of the Mark



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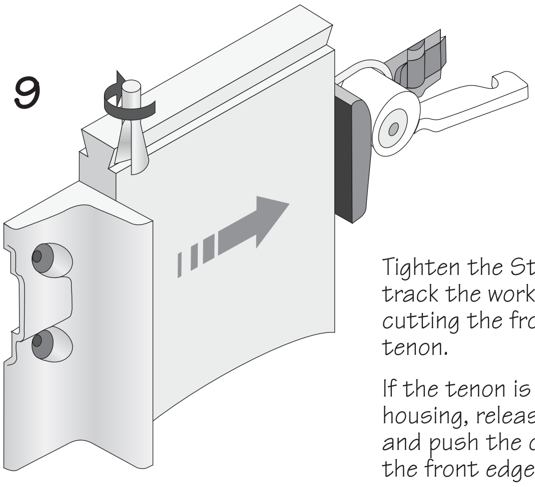
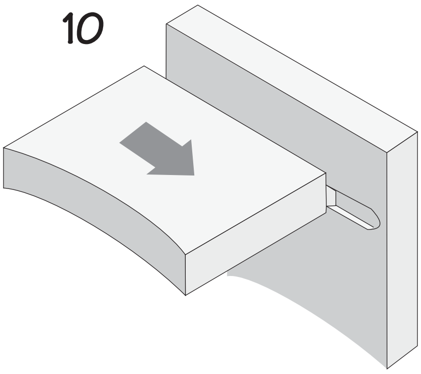


Tighten the Star Knob and track the workpiece right cutting the front side of the tenon.

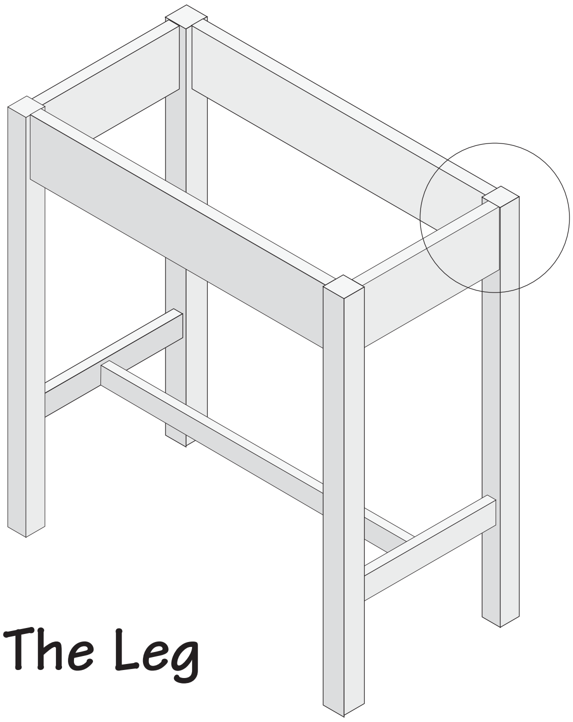
If the tenon is to fit a stopped housing, release the Star Knob and push the cutter through the front edge of the shelf.

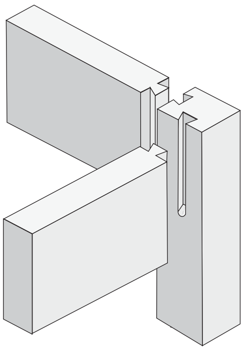
10



Try for a fit.

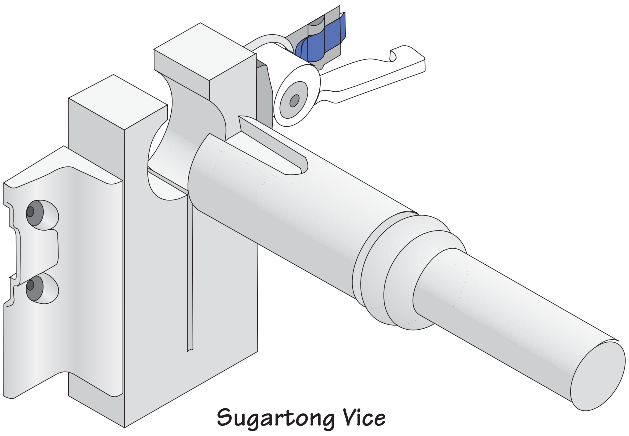
Putting a leg on a table with a Sliding Dovetail





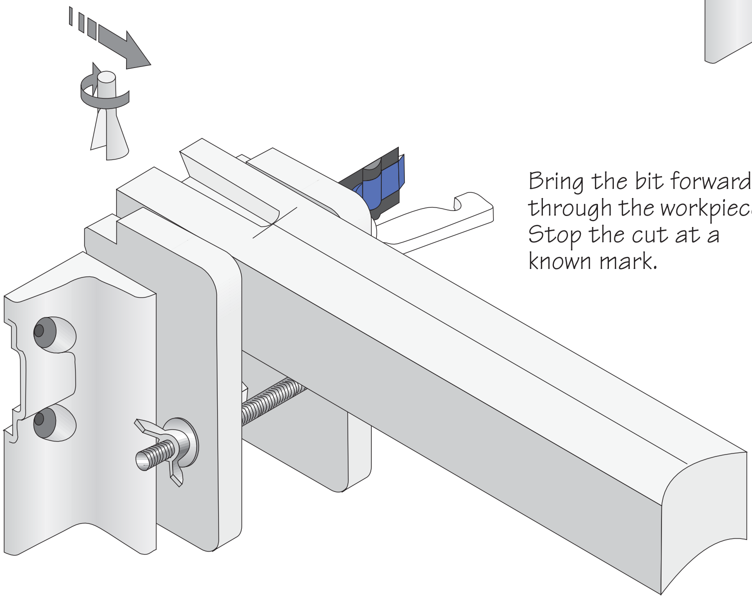
Perhaps the simplest way to put a leg onto a table is with a sliding dovetail.

Quicker than a mortice and tenon, yet much stronger than a dado joint, the sliding dovetail can be used not only with square pieces, but also round pieces using the sugar tong vice, (pictured below and described in the final section of this book).

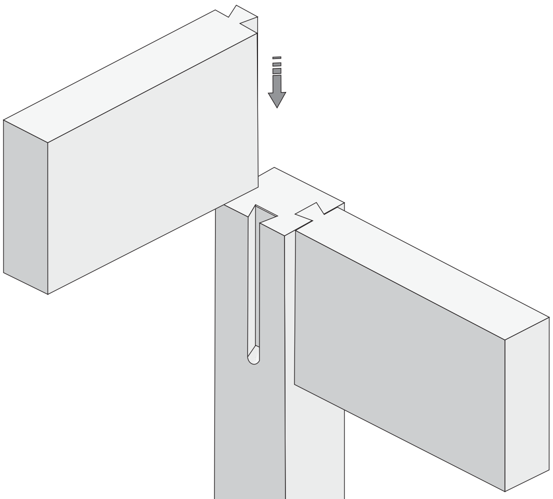


Sugartong Vice

The Leg



Bring the bit forward through the workpiece. Stop the cut at a known mark.

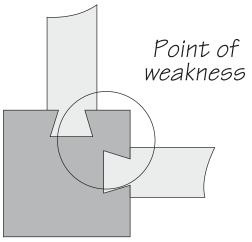


Choose a fairly chunky dovetail cutter. Either a WR-H-6-**36-20** or a TCT dovetail bit.

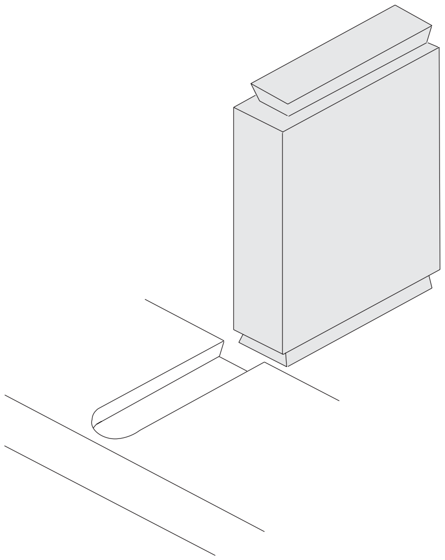
Mark out the leg with a single pencil line marking the centre of the joint.

Depth the cutter - not so deep as to weaken the leg.

Carefully place the leg in the Mitre Box up under the Plate and line up the pencil line with the centre of the cutter using the Centre Liner.



Sliding Dovetails in Rails

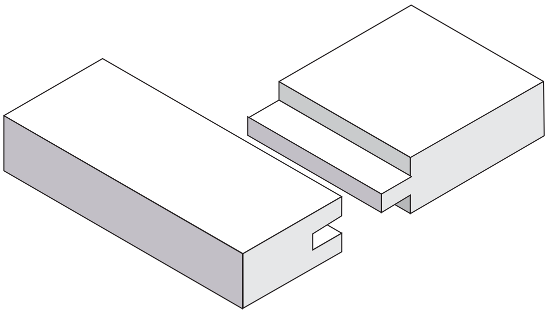


The carcase of a chest of drawers gives a different sliding dovetail problem from that of a set of shelves. The framework is not so deep and is made up of pieces, acting as rails and posts, and runners and kickers and so on. The problem is one of making an accurate framework for the drawers to fit into.

The test of a good set of drawers is that the drawers should fit accurately not only the right way up but also upside down. Not only that, but each drawer should fit accurately in every other opening of the same size. For this you have to be able to place the posts exactly where they are needed: exactly in the middle of the carcass, or exactly dividing the carcass width into three equal spaces, and so on.

The post needs to be restrained across its depth or a slight twisting in it will foul the drawer. Egg-crate construction using halving joints is therefore not adequate. It is common practise that the post should joint into the rail with mortise and tenons. This can be done. However, a sliding dovetail has advantages. It is faster to make and takes less out of the structure. The sliding dovetail is the correct joint.

Tongues



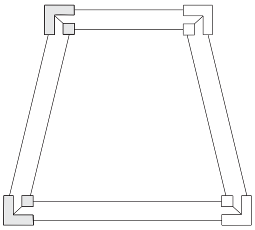
The simple tongue joint is made in the same way as other tenons.

A common use of this joint is in the supporting frame of a drawer. It is essential to get the frame to go together without joggle between the front rail with the groove and the rail which supports the drawer runner.

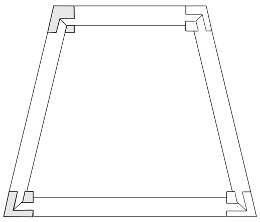
Chair Making

Angled Mortise and Tenon Joint

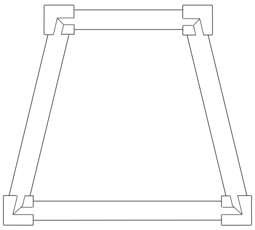
These are the classic ways of treating the mortise and tenon joint of a chair. Chair making is complicated by the way the side rails drop by 1/2” from front to back, to tip the seat back for comfort. The designer may need any one of these jointing methods, depending on the type of chair.



The tenon is at an angle to the rail and square to the chair legs



The tenon is angled to the legs and the the legs follow the angles of the seat. A barefaced tenon is used



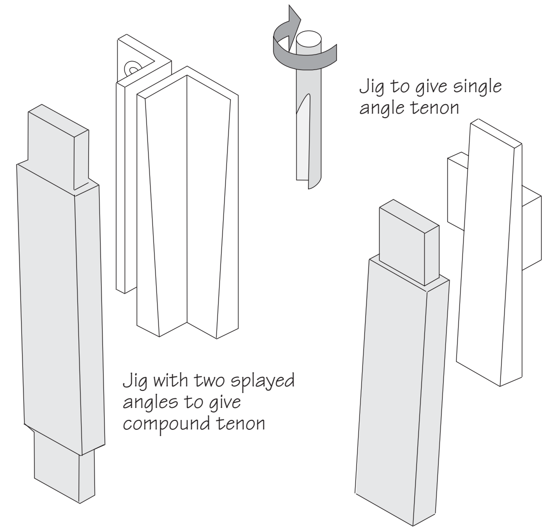
The legs are square but the tenon is angled with the rails

A constant angle jig can be simply knocked up to cut a straight tenon on an angled rail.

- The first of these examples is quite straightforward - a compound angle jig is used
- The second example can be made in part with the rail cammed in straight, but the router will not give the obtuse angle. This must be finished by hand.
- The third example is best made with solution 1, but otherwise make part in the WoodRat and part by hand.

Angled and Compound Angle Jig

Single Angle



Jig to give single angle tenon
Jig with two splayed angles to give compound tenon

Uses: Chair rails, Rails to rails at angles other than 90°, Splayed legs,

For any complex piece of furniture you will have a full-size drawing to work from.

1. From the drawing find the angle that the piece is to be placed at.
2. Make a long wedge shape to that slope, and glue a projecting tang square to the back of it. It will now hang in the tee slot of the Sliding Bar.

If the wedge is narrower than the rail the Cam Lock will tighten it at a consistent, repeatable angle.

Compound Angle

This is the device to make the rail for the backward sloping chair seat framework.

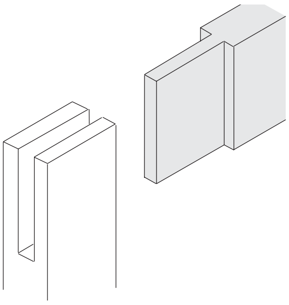
1. Make the second angle to the side view of the drawing to give the second angle to the piece.
2. Add this angled piece to the singled angled jig to make a compound angle.
3. Lay the rail in the jig and cam it in. The jig must be narrower than the rail, so that the Cam Lock closes on the rail, not the jig. Cut the tenon in the usual way.

Use the compound jig with the Mitre Box

When two tenons meet inside the same chair leg, they are mitred to fit together in the corner of the joint. If the leg and the compound angle jig are placed together into the Mitre Box. The tenon can be cut at 45° without difficulty, even though it is skew to the rail.

Bridle Joints

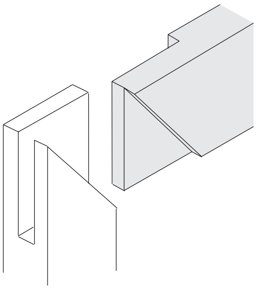
Slot Mortises



At its simplest, a deep cut in the middle of a rail will make a slot mortise. You need a good depth of cut for this. Plunge and cut by degrees so that you do not put too much strain on the bit.

You will inevitably get tearout as the cutter leaves the wood, so plunge to full depth at the beginning and end of the slot. Then there will be nothing to break out.

Mitred Corner Bridle



The mitred bridle joint gives a neat strong corner. As usual with mitres you can run any decoration straight round the frame.

You need a long thin cutter with good clearance.

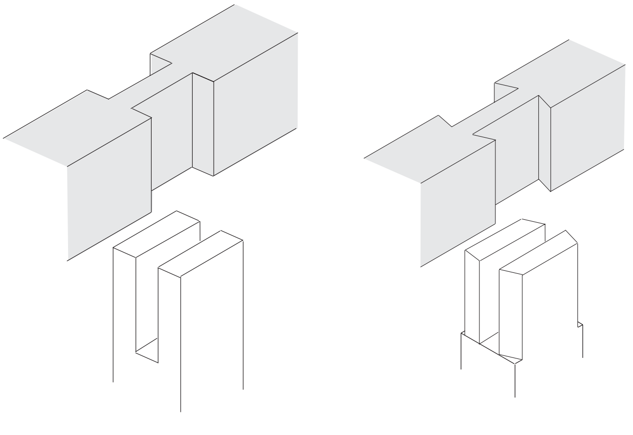
Setup:

The mortise and the square tenons are both made with the setup as for tenons.

The two 45° cuts are made with the Mitre Box.

Tee Bridle Joint

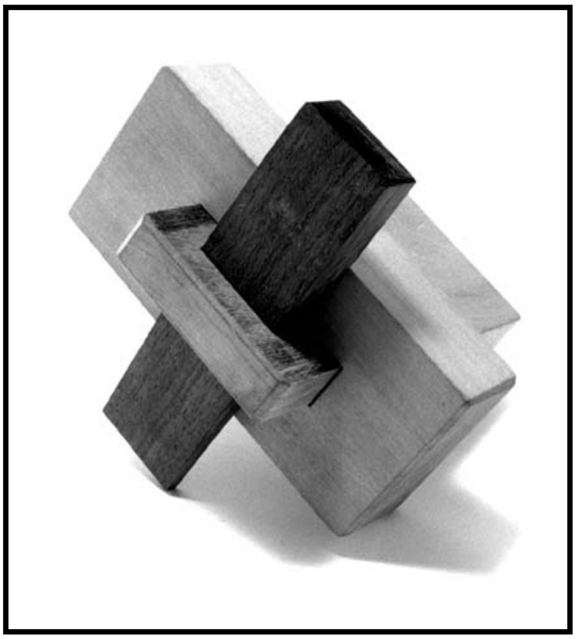
Ellis calls it a Forked Tenon joint. This is the classic joint for placing a leg in the middle of a table rail in a long table.



Also for muntins in wide paneled doors or counter tops.

For added stability it can also be made with a dovetail bit cutting the mortises in the rail, and the prongs of the leg dovetailed with the straight bit angled to fit.

Section 6



Mortising

Setting Up Mortises 64
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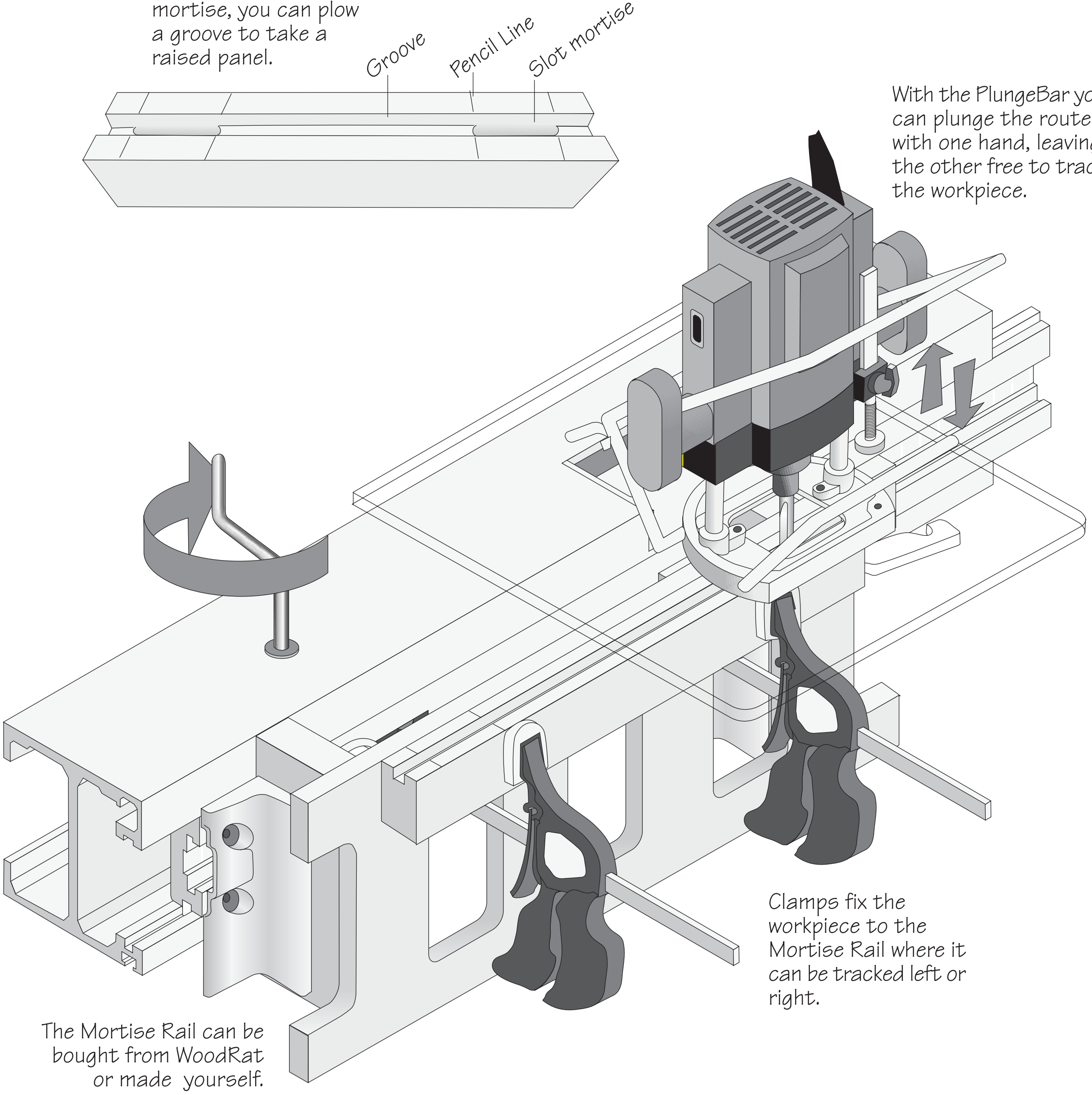
Mortising with the Mortise Rail



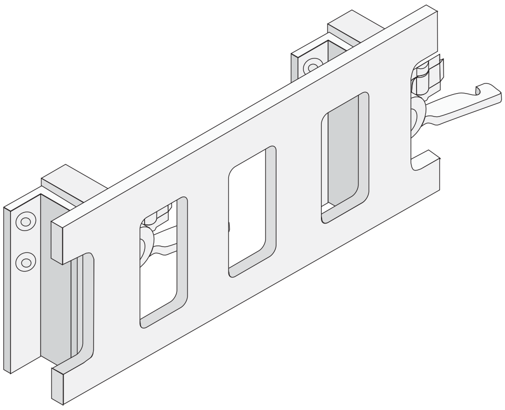
Before plunging the mortise, you can plow a groove to take a raised panel.

With the PlungeBar you can plunge the router with one hand, leaving the other free to track the workpiece.

Clamps fix the workpiece to the Mortise Rail where it can be tracked left or right.

The Mortise Rail can be bought from WoodRat or made yourself.

To Make a Mortise Rail:



1. Make two 2" x 3" x 9" / 50 x 75 x 225mm (approx.) pieces, and place them upright in either Cam Lock.

2. Screw a board of MDF or plywood, of whatever size you need, onto the uprights, as a Mortise Rail. It will now lie parallel to the face of the machine.

3. Mark out holes in the board. The holes are for you to put the toe of the clamp into so you can clamp your workpiece to the face of the MDF. Klemmsia or QuickClamps are best, as they work single handed.

4. Tip the whole Mortise Rail assembly up, so that the face of the MDF lies up under the Plate. Cut out the holes with a long straight cutter. The holes need to be large enough to put your hand through, because when you un-clamp and put the device in again vertical, you can pull on the Fixed Fence with your fingers, and push with your thumb, so that you take any rattle out of the sliding bar. It is essential that there be no movement, as everything has to be absolutely firm for mortising, and for plunging when drilling dowel joints.

5. Now plant your workpiece onto the Mortise Rail and clamp it firmly in place, and you can do any number of actions to it.

A workpiece can be up to about four feet (1200mm) long and larger pieces can be repositioned along on the Mortise Rail to be mortised.

Working with the Mortise Rail

It’s essential that there’s no sloppy movement, as everything – router bearings, router legs, cutter, workpiece, mortise rail, and clamps have to be absolutely firm for mortising, and for plunging when drilling dowel joints.

Plant your workpiece onto the rail and clamp it firmly in place, and you can do any number of actions to it.

A workpiece can be up to about four feet (1200mm) long, and larger pieces can be relocated along on the mortise rail, to be mortised.

Very long workpieces can be supported with rollers etc.

Use the Mortise Rail…

- As a mortiser: Work can be tracked East-West while it is being mortised. which makes it a very effective mortiser.
- As a router fence: Work can be fed through by hand, particularly panels and deep rails. You have the advantage of being able to support work with the brush clamped to the rail
- As a Panel Raiser: The mortise rail can be put into the Cam Locks at an angle which allows you to raise and field panels. See page 39.

Mortising

The mortise and tenon is the joint of framing, for furniture and for large timber construction. The joint has many forms to suit conditions as different as the king-post of a roof truss and a centre rail of a panelled door.

Mortises and tenons are spoken of in one breath, but they are made in totally different ways. There are three elements; the mortise, the tenon, and the means of locking them together. This can be either a pin, a wedge, or glue, and which you choose will determine the form of the mortise.

Mortises on the WoodRat

Mortises are traditionally cut first because they are a bit more difficult to adjust if they are made the wrong size. Shaving a sliver off the tenon is easier than trimming a mortise.

Another useful jointing machine is the hollow chisel mortiser. They make square mortises with flatish bottoms with ease. When it comes to general mortising they are faster than the WoodRat, because the socket is cut with square corners. But whereas one may not consider mortising a five barred gate on the WoodRat, there are jobs, for example smaller mortises, or dovetailed mortises, or mortises that you don't have a chisel for, where the WoodRat is excellent.

It is also much more sensitive for chair making than the average chisel mortiser. The WoodRat has the advantage of its fine tracking mechanism, and the ability to offer up awkward shapes to be mortised, and also to work at particular angles. Besides, not everyone owns a mortiser.

Mortises are made with the Mortise Rail, (see following page).

Set-up

Mortise Rail

Guide Rails

Star Knob

Clamps

Straight Cutters

PlungeBar, (not essential, but very helpful).

Cam Lock the Mortise Rail onto the sliding bar. Pull on the Fence and push with the thumb to make sure that the rail is firm. Clamp the work firmly to the rail, and press it up under the Base Plate to support the router against the downward push. There should now be no rattle in the whole assembly, otherwise the mortise will be ragged.

Note: *You can make mortises in door stiles and table legs, by holding the rail square in a Sugar Tong Vice, and plunging the router. This will allow you to put joints in the end of the rail, but it cannot reach the middle of the rail. For this we use a Mortise Rail to hold the piece on edge and across, so that you can reach any part of the rail.*

Cutting the Mortise.

1. Zero the cutter. Set the depth stop to the correct depth for the cutter. Plunge the router to drill a hole, 3mm from the left-hand end of the mortise. Un-plunge it at intervals to clear it, as it goes down.
2. Stop the router and find the exact left-hand end of the mortise, by placing the bit over the position. Start up again, and plunge the hole. Now clear right to the first hole, by tracking the work.
3. Plunge the next hole a little away from the first hole (on the right of it) and clear back to the first hole. The slot widens now. The next plunge is on the right of the slot, plunge, and clear back. Do this right up until the last hole, which may be exactly located, as before, with the router switched off.

Warnings

The object of this technique is to put as little strain as possible on the bit. It's rather like chopping mortises with a chisel, but using the bit instead. If the bit judders in the hole as you plunge, it is telling you that your work, or your router, is not firmly fixed. Make sure that you have pulled the Fixed Fence forward as you tighten the Cam Lock on the Mortise Rail.

- If it burns as you plunge the cutter, then it's telling you that you're chopping out more in one bite than you should. Don't over do it. Always use a razor sharp bit, with a good end cut.
- If the work is firm, and done carefully, the mortise should be quite clean. It will, of course, have rounded ends…

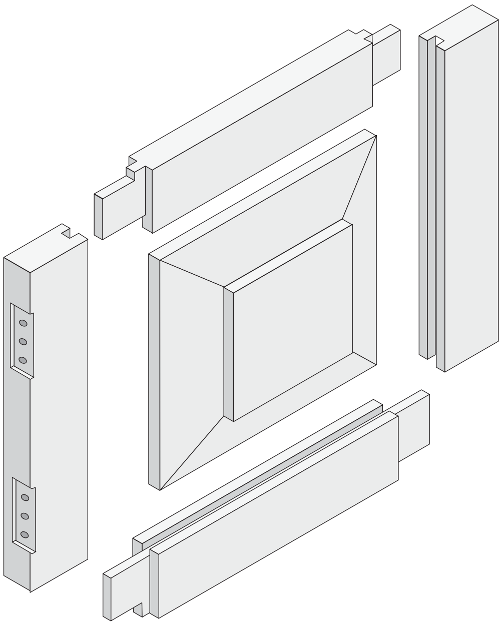
The Rounded Ends

Mortises made with a cutter have naturally got rounded ends, though the tenons are cut square.

The remedy is either to chisel the mortise square ended, which is the proper way to finish it, or to leave it rounded, and round off the tenons to fit. The second way is quickest as they don't have to be exactly rounded to fit.

With through tenons there's no contest: one should always square the corners, because it makes a stronger joint, and looks better, especially when the joint is wedged. But even when the joint is invisible, it's still best to square the mortises: it also more closely matches traditional work, and like those rounded corners that jigs make under dovetails, may be they cannot be seen, but you know that they are there.

Making a Panelled Door

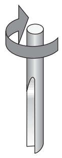


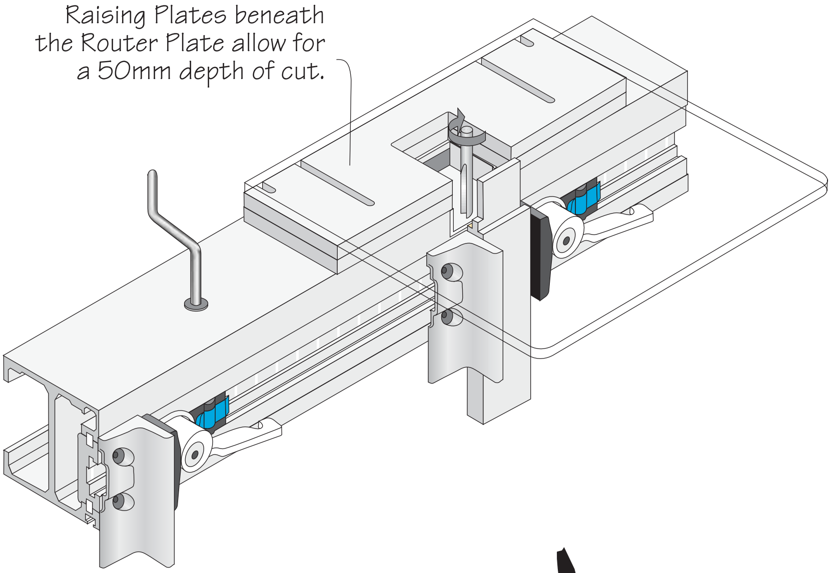
This exercise makes a panelled cupboard door using four Mortise and Tenon joints. Please read the sections on both Mortising and Tenoning before attempting it.

The haunched tenon is the classic joint of the cupboard door. The stiles and rails of the door are grooved to take the door panel. This groove determines the width and position of the tenon.

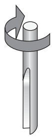
You make the haunch to the depth of the groove, so filling what would otherwise be an unsightly hole on the top of the door. This increases the stile's grip on the top and bottom rails.

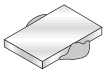
Setup for the Tenons

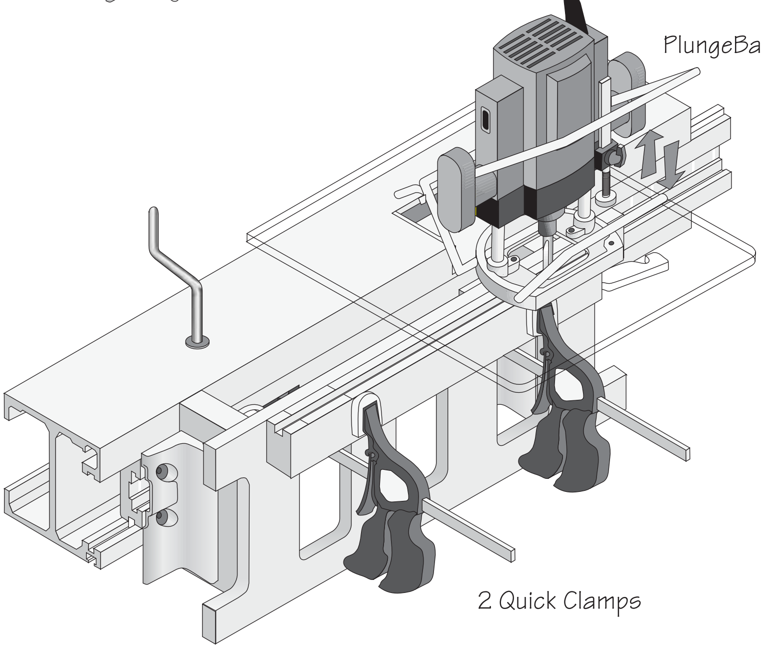




Setup for the Mortises







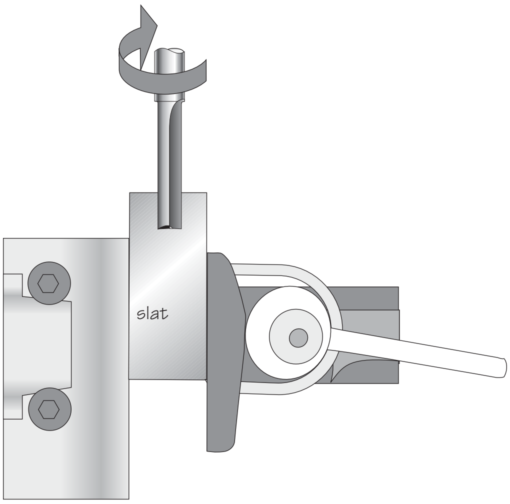
Cutting the Tenon

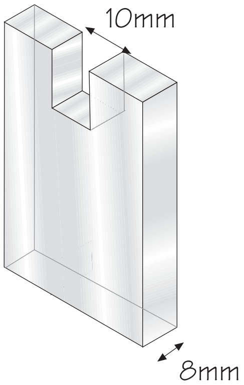
Setup:

Use a 1/2” 12.7 mm diameter Straight Cutter for the tenons.

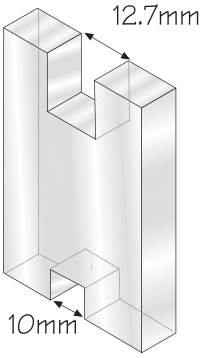
Use a 10mm Straight Cutter for the mortices.

Make the tenon first. It needs to be the width of the mortise (10mm wide), but cut it with a 1/2” bit.



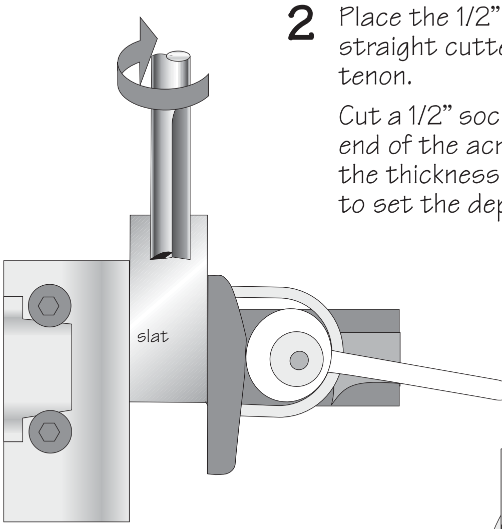


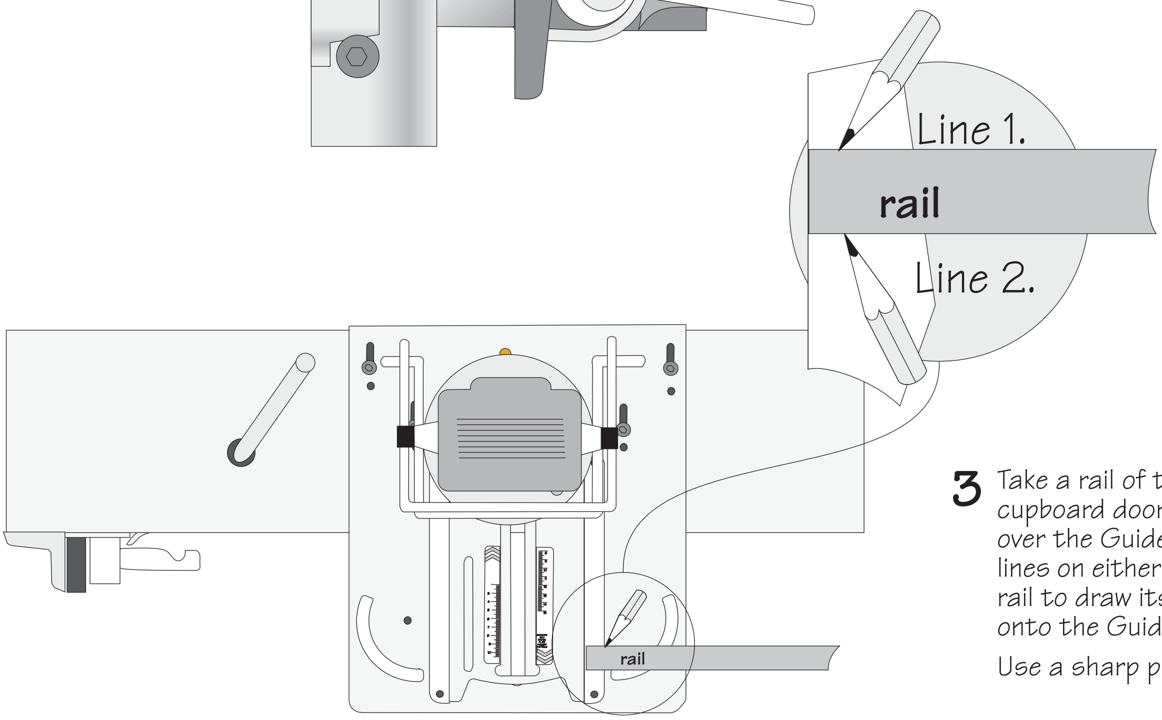
1 With the 10mm bit, cut a socket in an 8mm scrap of wood or an acrylic slat. This socket will tell us the exact size of the cutter, therefore the width of the mortice, and therefore the width of the tenon.



2 Place the 1/2” 12.7 mm straight cutter to cut the tenon.

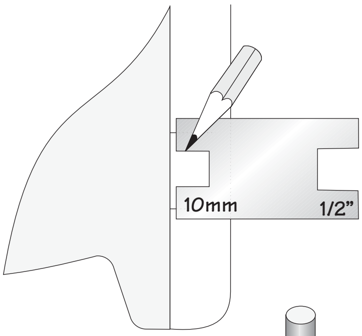
Cut a 1/2” socket in the other end of the acrylic slat. Use the thickness of the acrylic to set the depth of the bit.





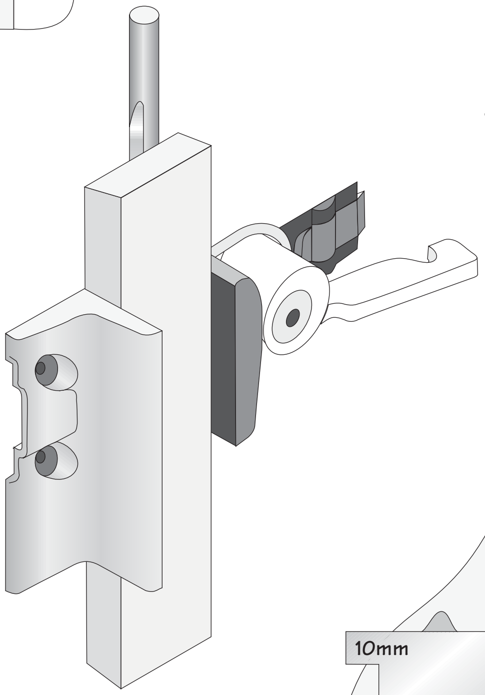
3 Take a rail of the cupboard door and lay it over the Guide Rail. Draw lines on either side of the rail to draw its thickness onto the Guide Rail.

Use a sharp pencil.



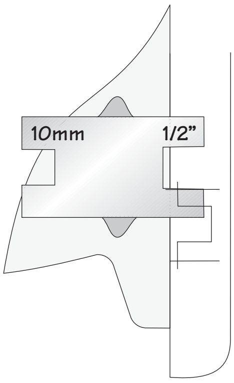
4 Lay the slat with the 10mm socket onto the drawing of the rail and stencil the joint size onto it.

The socket should be roughly central between the two previous lines.



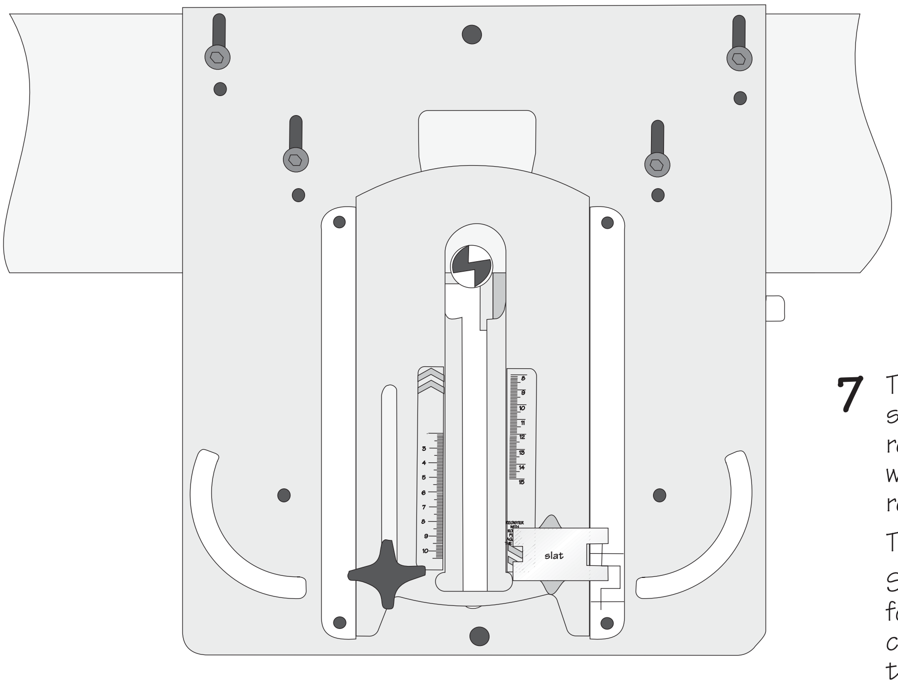
5 Depth the cutter to the full depth of the tenon, which will be slightly less deep than the depth of the mortise.

Lock the top rail, which will take the tenons, into the Cam Lock and bring the cutter, with the blades North/South, to the back of the rail, gently touching blade against wood.



6 Position the acrylic on the Router Plate, with the socket overlapping the Guide Rail and place it so that the 1/2” socket (representing the cutter) lies just against the back of the picture of the wood.

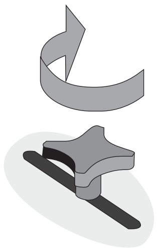
Fix the acrylic down with Blu-tac.



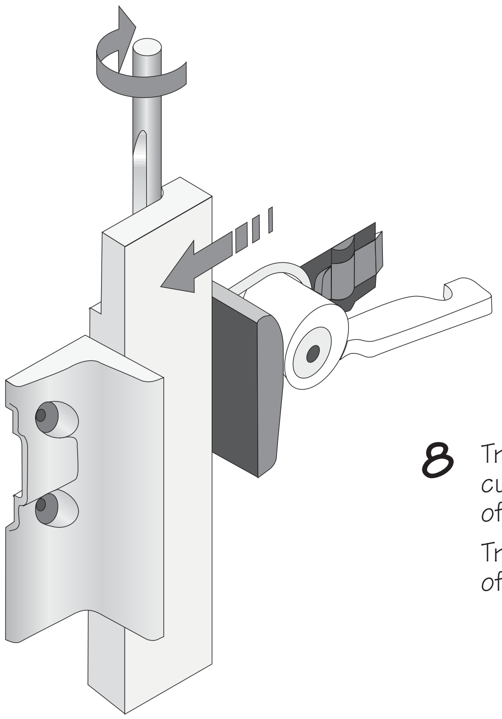
7 The picture of the cutter (the socket) is now in the same relationship to the picture of the wood, as the real cutter is to the real wood.

Track the wood away to the right.

Switch on the router and bring it forward so that the picture of the cutter lies against the picture of the joint drawn on the Guide Rail.

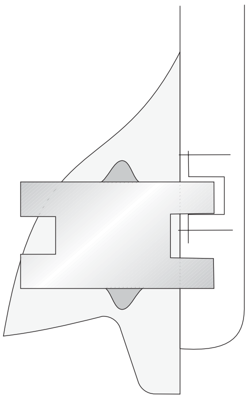


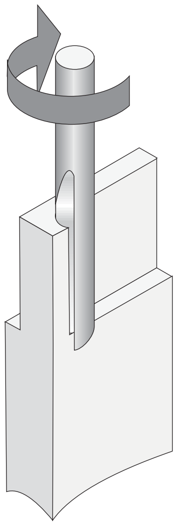
Fix the Router Plate down with the Star Knob.



8 Track the wood left, cutting the back face of the tenon.

Track the wood clear of the cutter.



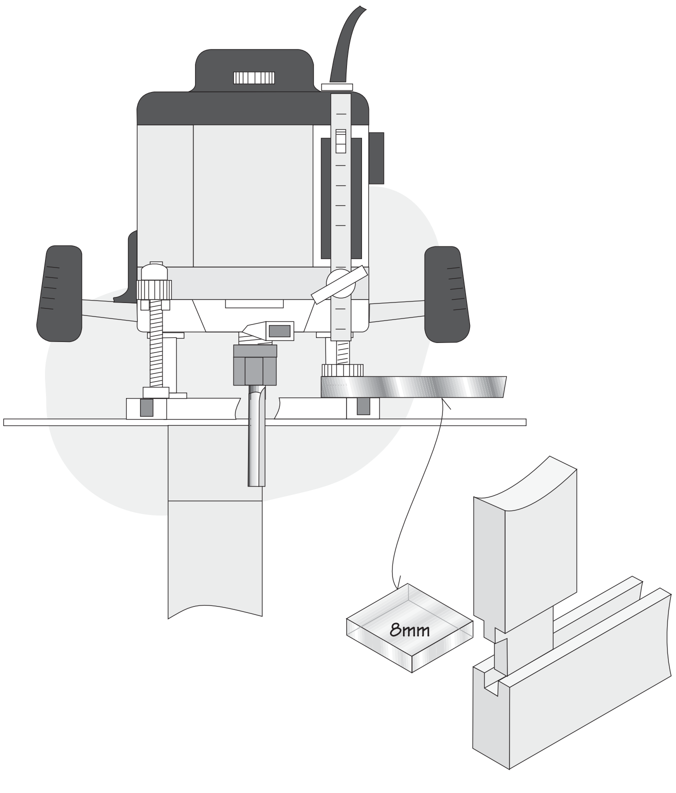


9 Slacken the Star Knob, and bring the router forward. Position the socket against the front face of the picture of the joint on the Guide Rail.

Fix the router plate again.

Track the wood back to the right. This will cut the front face of the tenon.

Check that the tenon is the right thickness - 10mm.

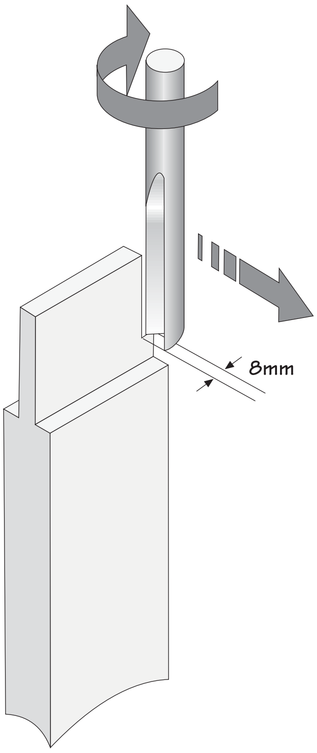


10 Finally, to make the haunch of the tenon:

First unlock the router and raise it enough to put the acrylic under the depthing foot.

Lower the router onto it, and lock it.

The router is now raised by 8mm (the thickness of the acrylic).

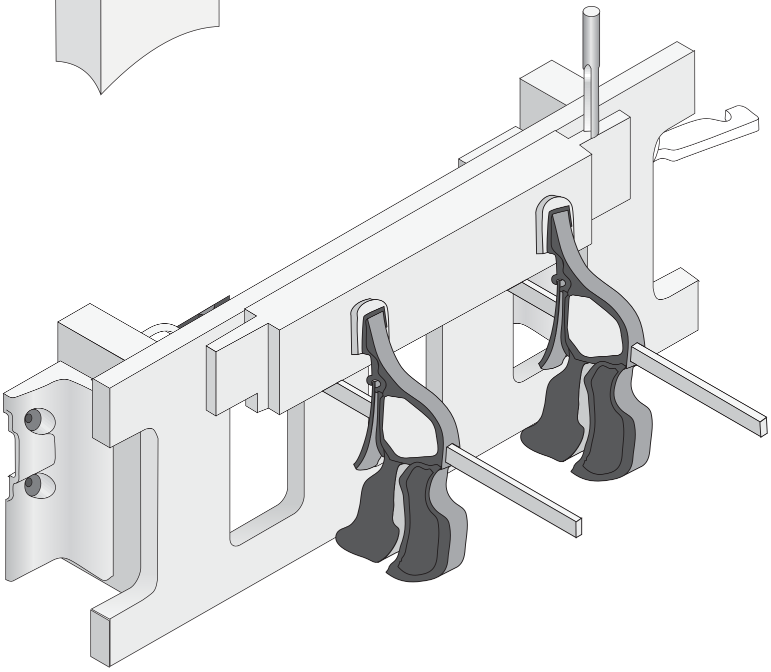


11 Cut off the outside edge of the tenon to create the haunch. 8mm should be sufficient.

The reason for this is to allow cover for the joint, when the wedges are driven home and the horn is cut off.

The first tenon is done. Now cut the other three tenons in the same way.

Ploughing the Groove



1 We now need a grove to fit the door panel.

Place the Mortise Rail and make sure it is firmly set.

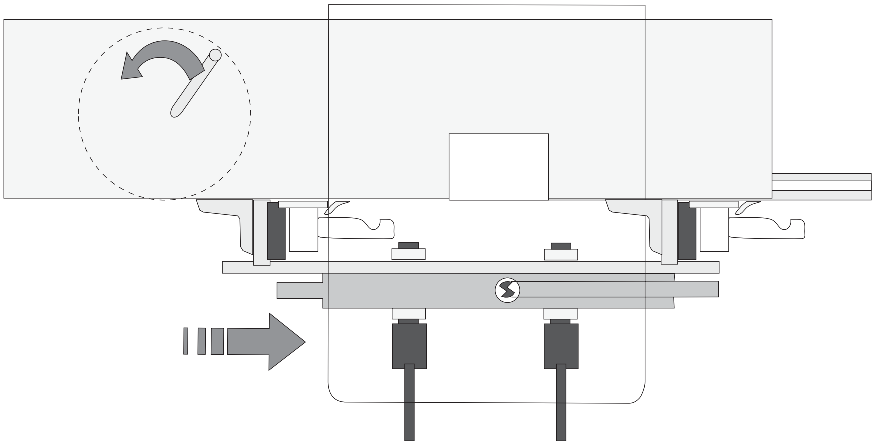
Clamp the top rail of the door up under the plate.

Change to a 10mm straight bit.

Zero the cutter onto the tenon and depth it using the 8mm acrylic again. Don't plunge it yet.

Fix the top or bottom rail onto the Mortise Rail as shown. Make sure that the correct (front) face is against the machine face. The haunches must face downwards.

Locate the cutter directly over the tenon and fix the Router Plate.



2 Switch on and plunge the router.

Track the wood to run a groove on the inside edge of the rail.

The groove should run straight through the tenon – exactly aligned.

Note that if the rail is fairly large, you may prefer to run the grooves by hand. In which case, remove the clamps and use the Mortise Rail as a fence.

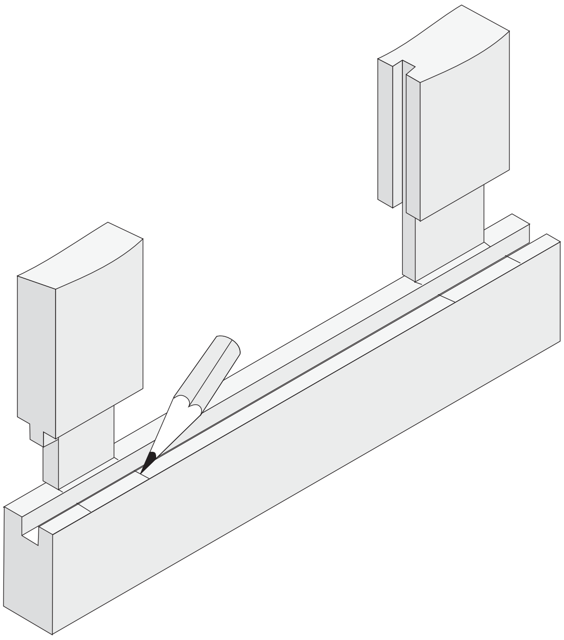
The Brush can be clamped to the Mortise Rail to give support.

Run the groove in both rails .

Repeat for both the stiles.

The grooves runs around the inside face.

Plunging The Mortises



1 Place the pieces over the cupboard opening. Position the two stiles in their final position and the top and bottom rails over the stiles.

Pencil the positions of the tenons on the face of the stiles and then transfer them to the inner edge with a square.

This tells you where the mortise goes.

2 Depth the bit for the full depth of the mortise.

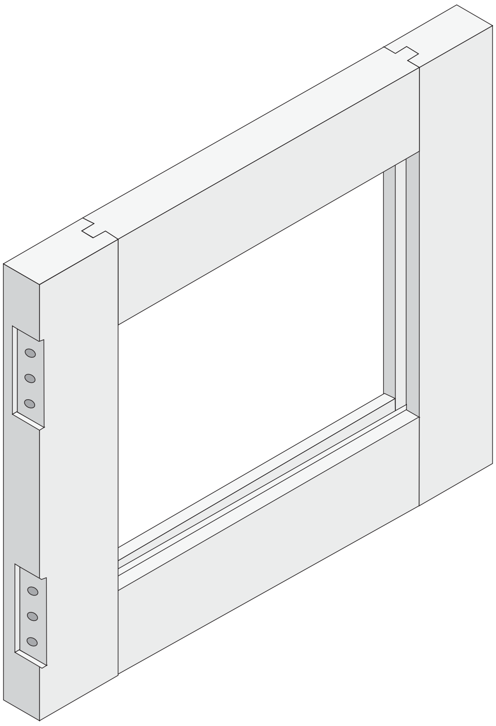
Clamp the stiles in place on the Mortise Rail and track the work so that you can see the pencil marks through the slot in the Base Plate.

The router should still be fixed in position. When you plunge the bit, it should go exactly into the groove.

Form a mortise between the two marks as described in the section on Mortising (page 62).

3 Square up the mortice with a chisel if you wish.

It will then be ready to take the tenon. The haunch of the tenon will fit exactly into the groove on the outside of the ring and the groove will run around the inside of the ring of rails.



4 Now you have the frame, you can see the exact size needed for the panel.

Form the panel as shown in the Profiling section and fit it.

Prepare to pin the joints, or wedge them, as you will.

Glue up.

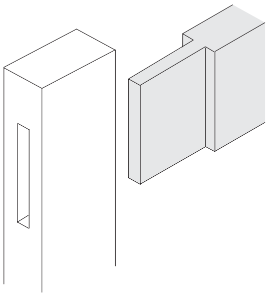
Cut off the horns, and fit the door.

Note that...

... You can also clamp the door to the Mortice Rail to cut the recesses for the hinges and the recess for the lock, and you can then cut the keyhole with a slot and a hole, and so on.

Mortise and Tenon Variants

Plain Through Mortise and Tenon

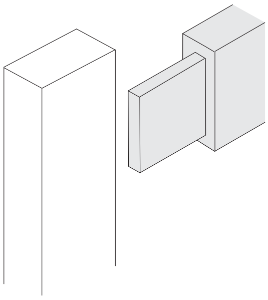


Set up for Mortise: Mortise Rail, Guide Rail ‘in’. 13 or 10mm x 50mm bit.

Use the Centring technique to find the centre of the stile. Cut the mortise through the upright, using the mortise cutting technique.

Tenon: Use one of the three tenoning methods to place the cutter, and cut the tenon, down-cutting each way to make the clean edge.

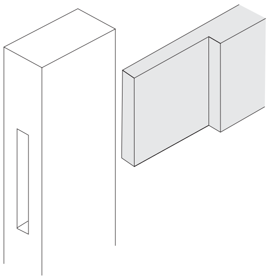
Stub or Stopped Mortise and Tenon



A simple mortise, and a simple tenon haunched all round, without complications:

The WoodRat will cut this joint in four easy passes. Compare this with the bother of making a stub tenon on a bandsaw.

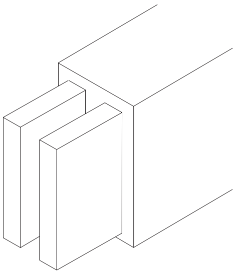
Barefaced Mortise and Tenon



This is a classic joint for chair making. Extreme care must be taken with the inside face of the joint, which has no shoulder covering the joint, although it tends to be hidden inside the frame.

This tenon can also be wedged.

Twin Mortise and Tenon



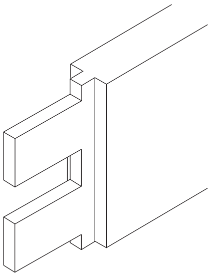
Working on the theory that two small holes take less strength out of a structure than one large one, the tenon is twinned and two mortises are made in the upright member.

This joint works well for wide members such as table legs and stretchers. The tenons can be:

- Stub Tenons with pins to hold them against tension, or
- Wedged, (and the wedges can be made of a different colour wood).

Important - *As you will make the mortises first, be sure that your bit will pass between the two mortises when you lay them out, otherwise you will have trouble when making the tenons. They will be too close together.*

Double Mortise and Tenon



When the members being joined are large, it is necessary to make the tenon in two parts either double (in tandem) or twin (side by side), to avoid taking too much out of the door stile.

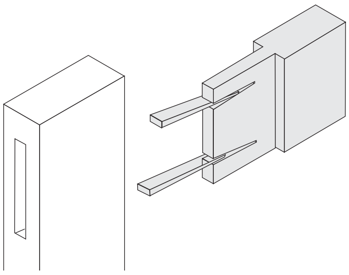
This is the classic joint for the centre rail of a door. The haunch is designed to fit into the groove that takes the door panels. Running right across the rail as it does it prevents cupping in the rail.

The Tenon is made double, to accommodate any latch or lock.

Locking Mortise and Tenon Joints

Wedged, Through Mortise and Tenon

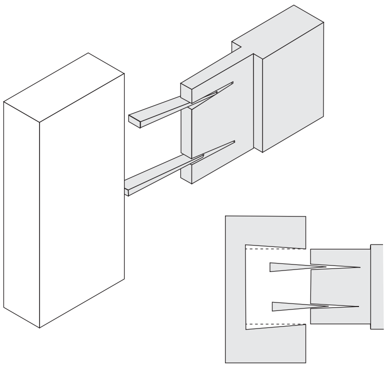
A through tenon made as above may be strengthened by driving in a couple of wedges to make a wedged tenon.



The rounded corners of the mortise must be squared off, and the socket worked from the outside with a chisel to make it neat and exactly square. At the same time, the end cuts of the socket can be sloped to shape it dovetailed. This will allow the wedges to widen the tenon as they are tapped home.

The wedges are later planed off flat. This is very satisfying to do, and the wedges can be in a contrasting colour to emphasise the joint.

Fox Tail Wedges



This provides wedges for the stub tenon. It is easier to do than it looks.

Make the blind mortise, and when squaring up the corners with the chisel to take out the rounded ends, angle the sides a little to dovetail the socket.

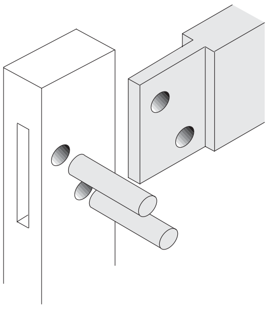
Make the stub tenon to fit the opening. Saw slots for the wedges.

Make Wedges and tap them into the slots lightly, just until the wedges start to open.

Now cut off the wedges a little from the end of the tenon. How much or how little is your guess. It depends on the softness of the wedges and the size of the undercut for them to squeeze into. Hardwood has to be more carefully judged than soft.

The wedges must not be allowed to push out the thin wall of the bottom of the pocket. Failure is to make the wedges too big, so that they do not allow the joint to close up. The wedges now hold the joint together in tension.

Pinned Mortise and Tenon

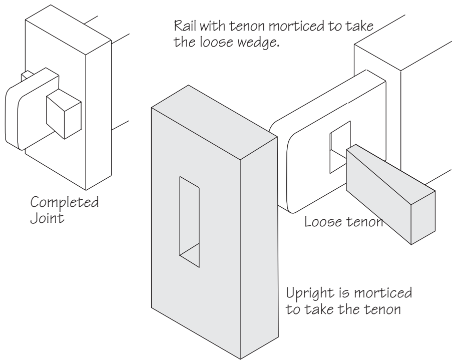


This is a way of strengthening the joint as an alternative to the wedge. Traditionally they were square pegs banged into the round hole and left proud.

Make the dowels with the Dowel Pop on the WoodRat using the wood that the door is made of.

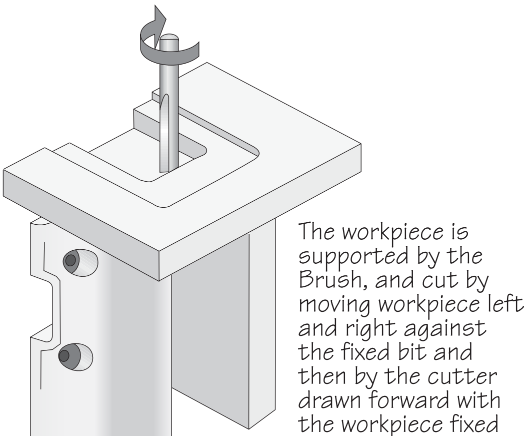
Use the dowels as draw pins, by offsetting the holes in the tenon relative to the holes in the stile.

Loose Wedged Mortise and Tenon


Rail with tenon morticed to take the loose wedge.
Completed Joint
Loose tenon
Upright is morticed to take the tenon

This is a favourite joint for knock-down furniture. If the joints are made large it can be very stable and robust, yet easily dismantled.

Recesses for Hinges & Locks



The workpiece is supported by the Brush, and cut by moving workpiece left and right against the fixed bit and then by the cutter drawn forward with the workpiece fixed with clamps to the Base Plate.

Among the many simple tasks that can be quickly and accurately done on the LittleRat are recesses for locks and hinges, escutcheons, brass corners and inlays.

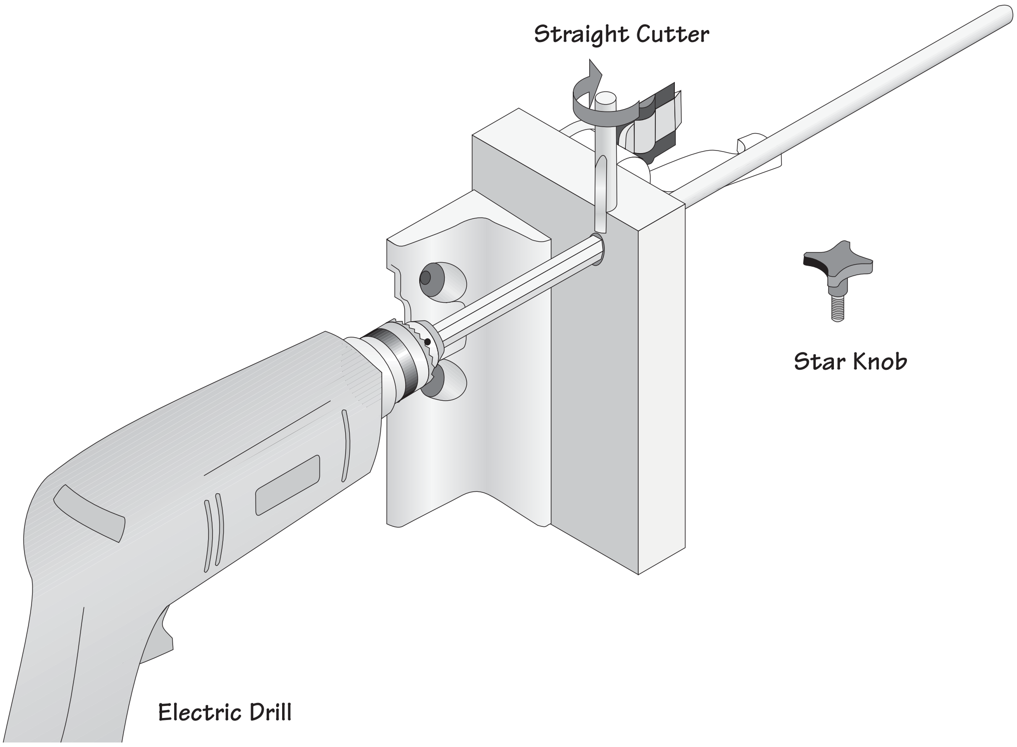
Cupboard door rails or drawer fronts can be placed in the Cam Lock before glueing. Boxes and small pieces can be worked on after they are glued up, the box being treated as a single block.

The art of recessing is in the depthing. Zero the cutter onto the surface of the work-piece as it sits in the Cam Lock or on the Brush. Then use the ironmongery, (hinge etc.), as the sandwich between depth gauge and depth stop to gauge the depth of plunge, and then lower the router.

Set-up: Use Guide Rails and Star Knob, Box or The Brush for horizontal work. Alternatively, use the Mortise Rail for vertical work such as hinges.

Dowels

Set Up



1. Take a block of hardwood and drill a clean hole in it with a cutter or a drill, to the diameter of dowel you need. Cam it square in the Cam Lock with the hole well clear of the Cam Lock handles.

2. Prepare a stick for the dowel, roughly round and sharpened like a pencil at both ends.

3. Now set a cutter spinning, exactly at the top edge of that hole, and a quarter diameter projecting in front of it. Rotate the stick, by hand, and at the same time push it into the hole. As the stick rotates, the cutter trims the end, and sizes it exactly to the size of the hole. As you push and rotate the dowel the cutter cuts it so that it can go further in. When the first end is shaped about 25mm, you can take it out and put it into the chuck of an electric drill.

4. Now spin the stick using an electric drill, and spin it faster, against the rotation of the cutter, to give a more even finish to the dowel.

Tip: If the stick is loose and badly cut, raise the bit a fraction.

Because you need to fit your hand or the nose of the drill under the WoodRat Base Plate, it is best to use a long straight cutter with a good end cut and position the hole well down. The block is therefore placed square to the machine face, as it gives more room to work.

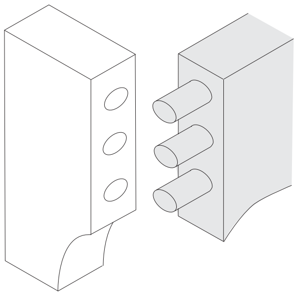
Important. Take care that you don't continue pushing the stick to where your drill is in danger!

Tip: If you need a tighter fit to the dowel, make a saw cut through the hole, and put a wedge in the saw cut so that the hole will open slightly wider under pressure (like the Sugar-Tong Vice). You can then make the dowel slightly oversized so that it will be a slightly tight fit when tapped home.

Dowel Joints

Dowel joints are butt joints reinforced with short pegs of round wood glued into round holes drilled opposite each other in the opposing faces. The art lies in accurate drilling. The holes have to be rightly positioned and dead in line. There are several proprietory jigs for this, but the WoodRat has advantages.

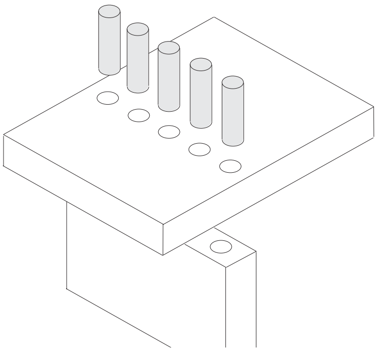
Dowel framing Joint



Dowels can be bought as prepared timber rods and cut down to length, or can be fully prepared fluted dowels, or dowel rod can be made using the WoodRat.

The Pieces are clamped to the Mortise Rail so that odd-shaped workpieces can be drilled.

Dowel Carcassing Joint For Shelving



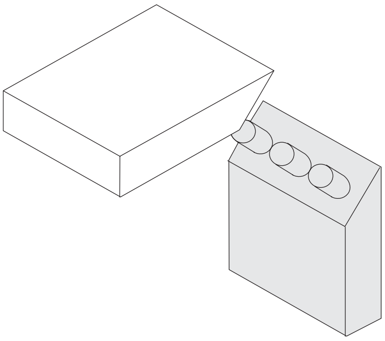
1. Position the Shelf up under the Carcase Side.

2. Take the Side out and check the position of the shelf, tracking it exactly central under the router.

3. Put the Side back, clamp it under the Base Plate in place and securely to the Plate. Plunge the router (fixed) into the side and through into the end of the shelf.

This way all the holes will line up exactly.

Carcass Mitred Dowel Joint



Dowelling joints are of two kinds:

- Dowelling with short lengths of dowels replacing pins.
- Making the ends of rails into dowel joints to fit drilled sockets as in chair-making.

The first type is made of short lengths of dowel as a pin that fits into both parts of a butt joint. They are usually made with some kind of jig, since the exact location of the two opposing holes is crucial. Drilling the ends of boards is usually a difficult operation as the drill stand has to be located above the plank end. This is no problem for the WoodRat. The plunge facility of the router and the clean cut of the cutter make for accurate dowelling.

The matching boards are first entered into the Cam Locks at 45° and the ends mown flat.

The hole positions are located and the holes plunged.

The parallelogram is used to get even spacing on a Marker Board, but it is best to use the single line method, with the lines on the board exactly square across, so that they will be accurate when the board is turned over to act as Marker for the second board of the joint.

Section 7

Finger Joints

(an introduction to East/West Registration)

Finger Joints

(an introduction to East/West Registration)

Introduction

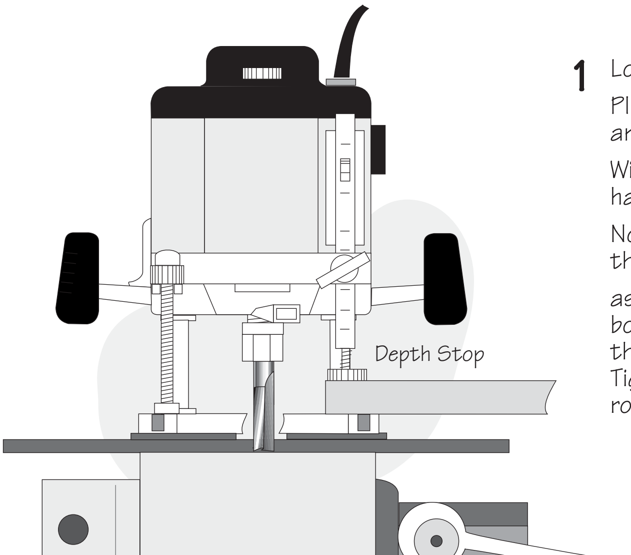
We have included this short section as a prelude to making Dovetails, as it provides a simple exercise in East/West registration, without needing to change cutters or reconfigure the machine.

Set up

Set the machine for straight cutting with Guide Rails in place.

Fit a 1/2' Straight Cutter (WR-S-50-H).

Prepare two boards of identical width and depth. For the purpose of this exercise, you could mark one as board A and one as board B.



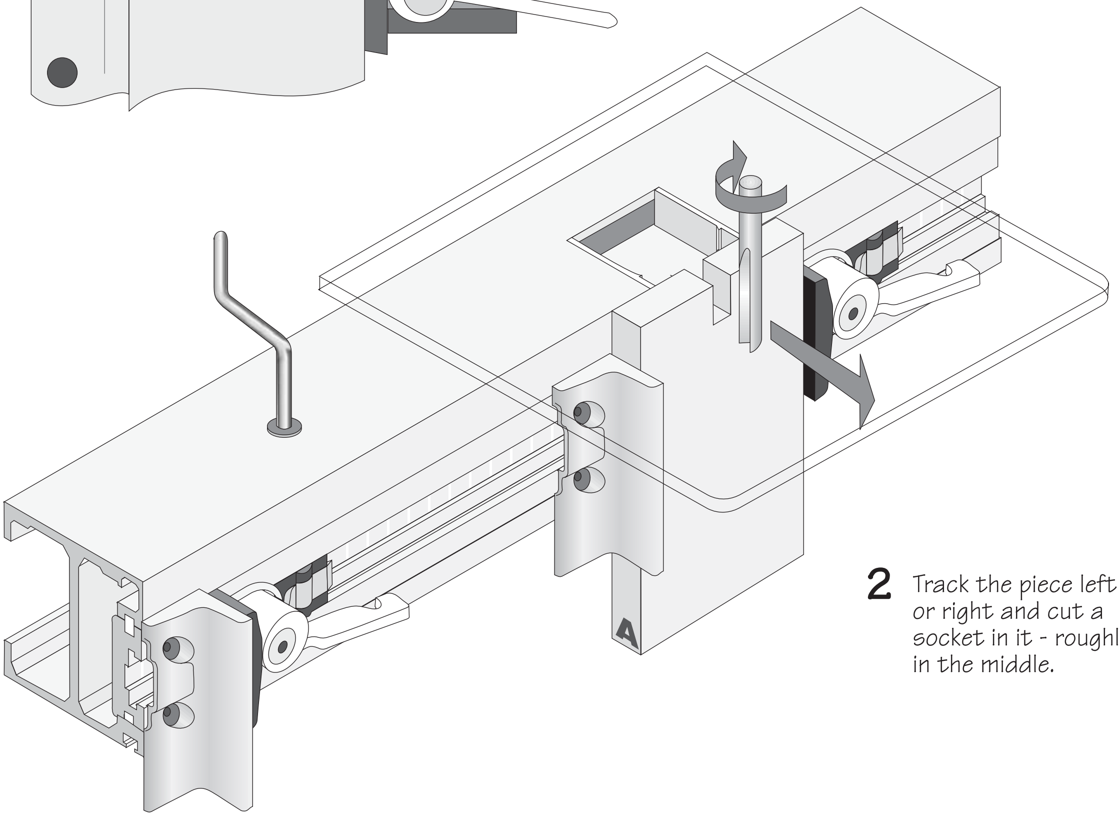
1 Lock Board A in cutter position under the Base Plate.

Plunge the cutter on to the top surface of the workpiece and lock the router.

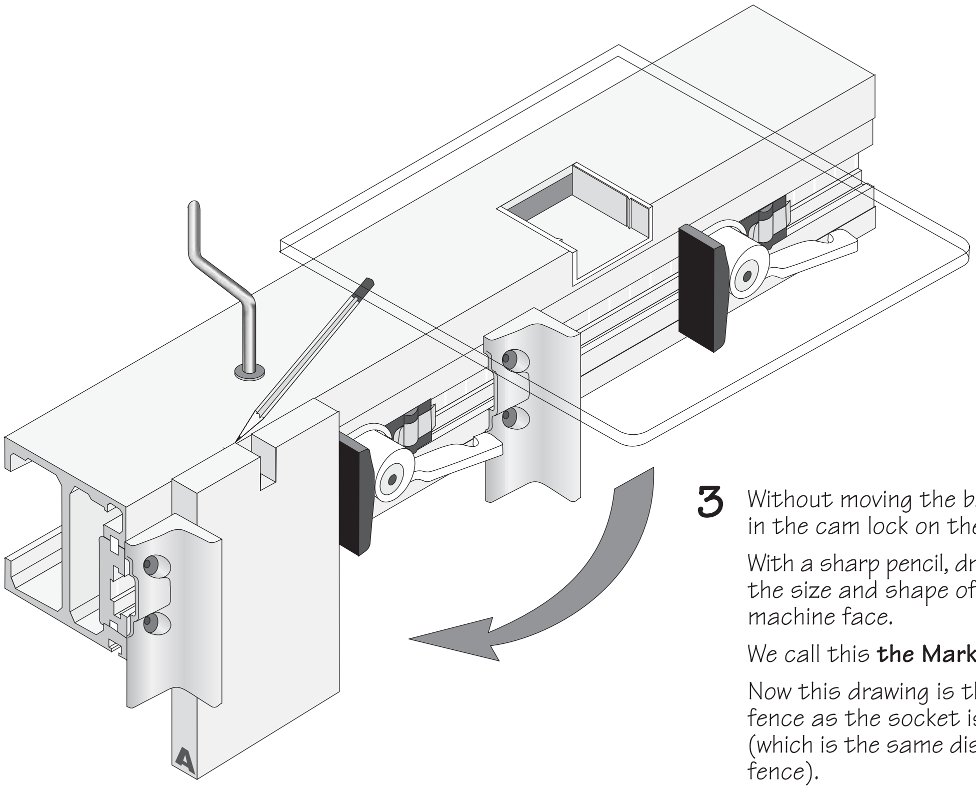
Wind down the depth stop foot onto the router base. This has 'zeroed' the bit using the depth stop.

Now lift the depth stop foot the amount needed, using the depth scale or;

as you are depthing the router to the depth of the marker board, you can put Board B between the router base and the depth stop and bring the stop down onto the board. Tighten. Take out the board. Now when you plunge the router, the bit will be a board thickness deep.



2 Track the piece left or right and cut a socket in it - roughly in the middle.



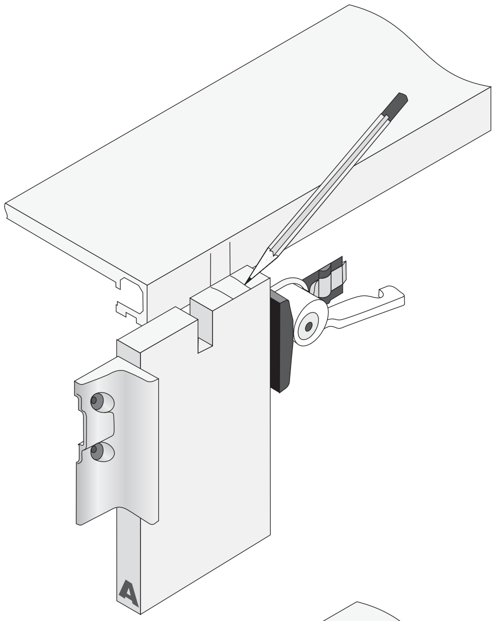
3 Without moving the bar, unlock the piece and fix it in the cam lock on the left.

With a sharp pencil, draw inside the socket, marking the size and shape of the cutter directly onto the machine face.

We call this **the Mark**.

Now this drawing is the same distance from the fence as the socket is from the edge of the wood, (which is the same distance from the cutter to its fence).

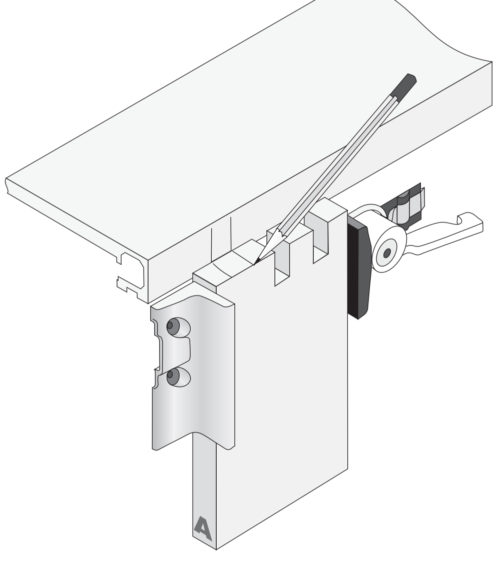
If you move the sliding bar an inch left, the cutter fence will move an inch too, because they're both fixed to the same sliding bar.



4 The picture of the socket tells you where the cut comes.

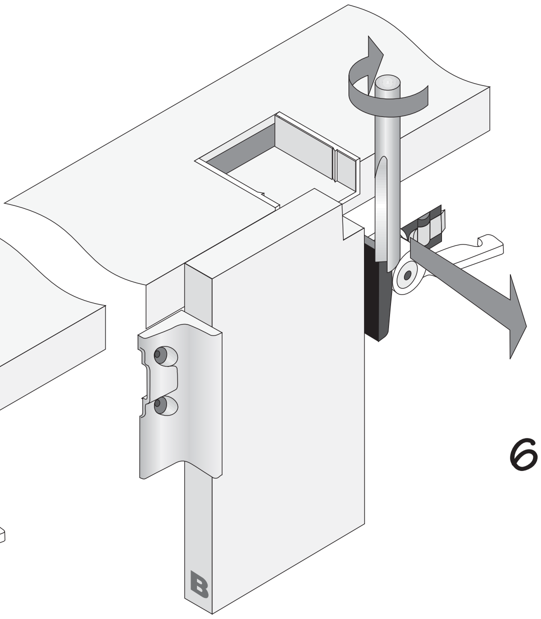
Mark out the second socket position.

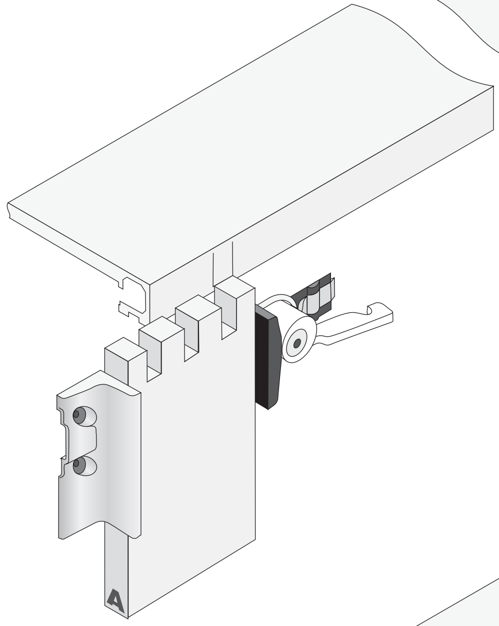
Take the wood back to the right-hand fence, cut a second socket and you'll see.



5 Put the wood Back on the left-hand fence. Pencil on the wood where you want the third cut to be, track the sliding bar so that the pencil marks line up exactly in front of the Mark on the machine.

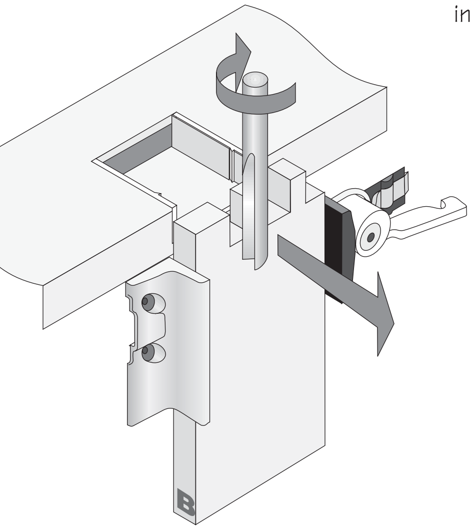
Put the wood back on the right-hand fence and cut the third socket. This makes the first part of the joint.

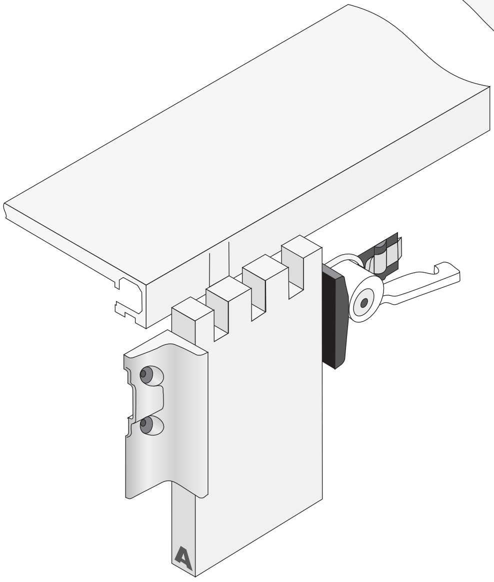




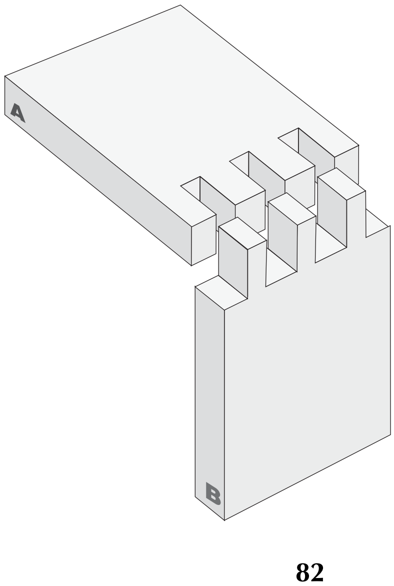
6 The first part now becomes a template for part two: the wood is aligned against the pencil picture of the cutter, in the same relative position as the actual cutter will be lined up against the workpiece beneath the router.

- Align the wood (not the gap) in front of your Mark.





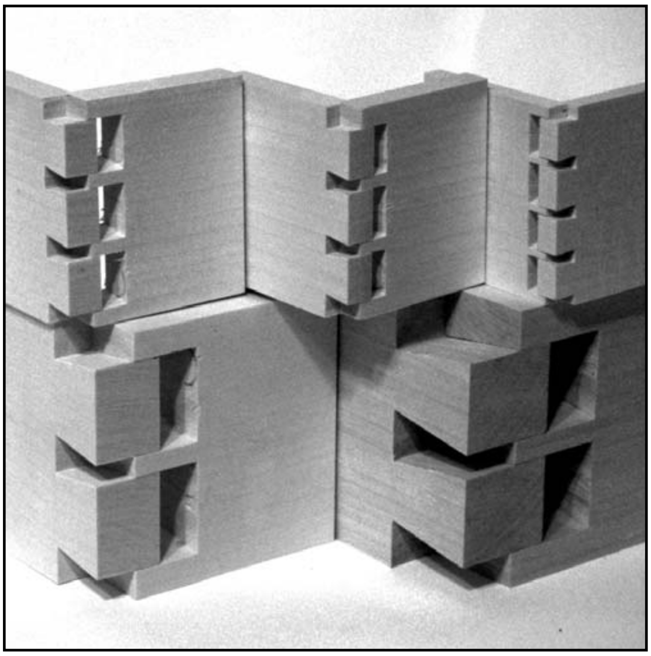
7 Place workpiece B in cutter position and cut away the wood, looking on the left to to see where the cutter position is in relation to the wood of the template.



9 when all the tenons are done, take the second part of the joint out and try it against the first....

...and it fits!

Section 8



Dovetailing

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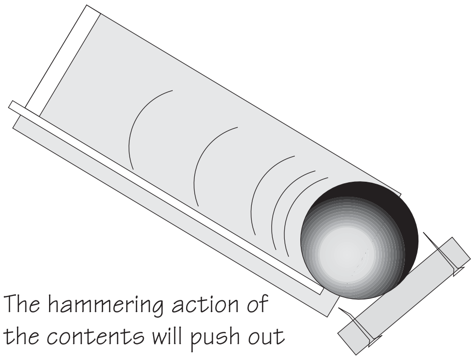
Dovetails Made Easy

Which Piece Has The Pins; Which The Tails?

Imagine a rough nailed up box with a cannon ball rolling around in it. You will readily see that the ball gains the greatest momentum pelting down the long side and will tend to smack the ends out of the box.



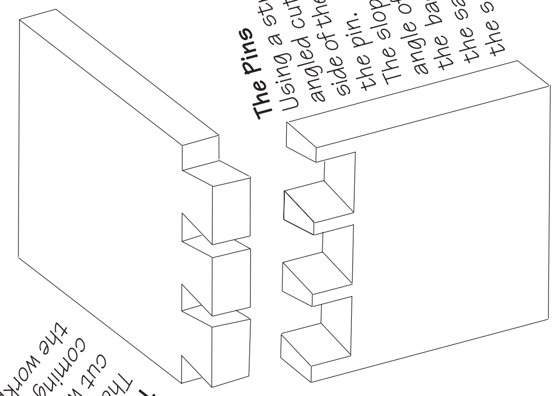
The hammering action of the contents will push out the front of the drawer, unless there is some way to lock it in place.

We need to nail it through the sides into the ends, otherwise they'll pull straight out. It's the same with dovetails made in wood, except that the pins, acting like the nails, are formed in the ends and go through the sides. They are wedge-shaped to fit into wedge shaped sockets cut in the sides. The Sockets are more like lobster claws than doves' tails, hanging onto the pins, which are wedge shaped to prevent them slipping out of the grasp of the claws.

It's relatively easy to pull the pins from the claws sideways. That's why the sockets are cut in the long side and the pins go in the ends.

Six things you must get right

1. Depth of cut - The better the depthing, the less cleaning up is needed.
2. Position of pins - WoodRat registration makes this easy.
3. Angle correct.
4. Size correct.
5. Boards match up - not joggled.
6. No tearout.

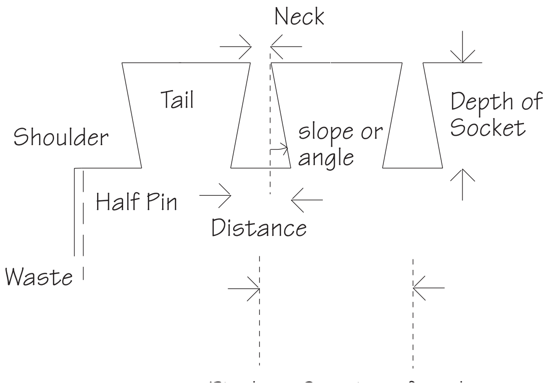


The Pins
Using a straight bit, two angled cuts are made either side of the pin position to form the pin.
The slope is the same as the angle of the dovetail bit, and the base of the wedge is made the same size as the base of the socket.

The Sockets
The dovetail sockets are cut with a dovetail bit coming straight through the workpiece.

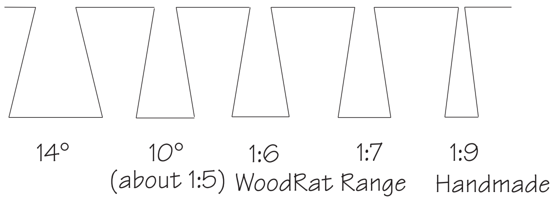
Dovetail Angles

The slope of the dovetail (its rake or bevel) obviously gives it its holding power. The joint will sometimes need to resist a straight outward pull, as when there are objects banging about in the box, but more often the forces are trying to distort or collapse a carcass or box, as when you stand on it, or drop it on its corner. This distortion subjects the joint at the corner to eccentric forces. So what angle should the dovetail be? Obviously, too little angle and the pins will pull out through the wedge. The joint fails as the wood compresses, the glue cracks, and the pin squeezes out of the socket.



On the other hand, with too great an angle the distorting action will cause the tips of the tail and pin to be sheared off. The joint will fail because the wood fails. The harder the wood, the less compressive it is, and the less the angle may be, and vice versa.

Softwood, being more compressible, needs a greater angle, up to the point where the dovetail tips tend to shear.



The limits of this are between 1:5 for softwood, and 1:9 for good hardwood.

How is the angle measured?

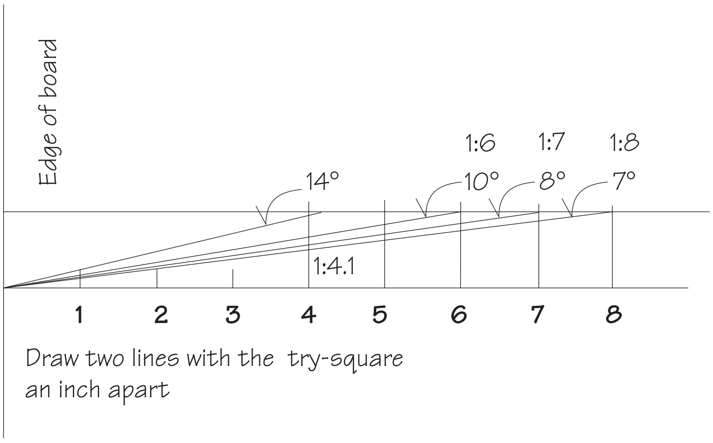
A Joiner rarely uses protractors to measure angles because they are difficult to measure accurately. Instead he uses a sliding bevel and a square edge on a piece of scrap. This can be dead accurate (when he needs accurate angles the engineer uses this method too).

The angle of the handmade dovetail can be very finely tailored to match the look of the piece in hand. A machine-made dovetail must compromise. A dovetailer that cuts tails and pins at the same time (indeed without distinguishing between tail and pin) like the DeWalt jig or the big Brookman, needs a wide stocky cutter shape. As a result, the joint looks machine made.

The WoodRat makes the tail and pin separately, and can therefore space the pins where they are needed, with total flexibility. We chose a slope of 1:7 for the smaller cutters, assuming that they would be used more for hardwood, and 1:6 as a slope angle for the larger cutters assuming that they would be used for softwood. We also want them to form a finely graded set.

Degrees and slope numbers

Whereas cabinet makers have been using the slope method of making exact angles for his dovetails since before the pyramids, an engineer's bit cutting lathe is marked out in degrees of angle. Therefore manufacturers usually catalogue their dovetail cutters in degrees following the machine reading.



Draw two lines with the try-square an inch apart

The marking out method for slopes is easily done with a try-square, pencil and bevel, working from the edge of a board

This tells us that there is not much liaison between the manufacturer and the craftsman (as no one who uses a router needs telling).

WoodRat uses the slope number to describe its bits, not the angle. We are the only ones in step here, and in this case we are right, as you will see.

The fact that a cutter has a 1:7 slope is useful knowledge. All sorts of things need to be made at 1:7 and can be easily made so with a bevel. Ten or fourteen degrees is meaningless in the woodwork shop.

HSS vs. TCT Dovetail Cutters

WoodRat's dovetail cutters are made of High Speed Steel, (HSS). Nearly all other dovetail cutters are Tungsten Carbide Tipped, (TCT).

The characteristic of High Speed Steel is that it is tough and flexible and is formulated to work at high speed in general engineering, hence the name.

HSS woodworking Router Cutters are designed to cut aluminium and most acrylic plastics as well as hardwoods and softwoods in a router going at 22,000 rpm. Because HSS is flexible, cutters can be made with a high rake angle. This is the basis of the sharpness of the cutter and gives the knife-like slicing action that is so satisfactory to work with. The low angle and the speed give good chip clearance, and that and high feed rates keep down the heat build-up. Less heat means less resinous gunge and no need for teflon coating.

The prime attribute of an HSS bit is that it takes a good edge and can be honed by the operator on a daily basis without its going off to the grinder, just as an artist might sharpen his pencil before beginning work. It can be kept sharp on an oil stone or a diamond hone. Another important attribute for a dovetail cutter is that both blade and stem are structural, so it can be as finely shaped as the strength of the shaft will allow.

The WoodRat working methods take good care of cutters; bringing the router forward very carefully into the workpiece, straight and square, without the bit wobbling in the cut, as inevitably happens when routing freehand. It is much less prone to accident.

Tungsten Carbide Tipped bits on the other hand, are made on a different principle. Instead of the shaft and cutting blades being one and the same, the two carbide steel tips are welded onto either side of the shaft. The shaft is structural, but the tips, sticking out from it, are not. Inevitably the bit, and therefore the pins cut from it look clumsy by comparison.

Dovetail Jig manufacturers all use TCT cutters. This is why dovetail bits from them might be the right angle, but are in no way as elegant as WoodRat bits. In fact, using a fine angle on a wide cutter makes the result look less refined.

Through Dovetails

Dovetails on the WoodRat employ ‘East/West’ registration in a similar way to making finger joints (page 80). The shape and position of the dovetail cutter is recorded as an accurate pencil mark on the left of the machine (in Marker Position) and this tells us where the actual cutter will cut a board clamped in Cutter Position.

With this technique you can include any reasonable number of dovetails with any spacing between them.

In this section, we provide some detailed information on dovetailing, followed by a step-by-step guide. We suggest you read through the whole section before following the guide.

Set-up

Take off the Guide Rails. Place the Centre Plate. Bring the left-hand spiral to the Square Mark (see page 94). Make sure the Front Stop is in place.

The Parallelogram is attached to your Wall Plate so that it can be swung forward over a board when in Marker Position.

Setting the Spirals to cut Square

Up until now you’ve used the WoodRat with the GuideRails in place to cut square. However, the left-hand spiral can also be used to cut square and this saves time when making dovetails. You need to make a ‘square’ mark:

1. Using a try square, check that the BasePlate lies square to the WoodRat face.
2. Put your square against the front edge of the BasePlate and against the edge of the RouterPlate and set it Square. It is now at 90° to the face of the WoodRat. Bring in the left-hand Spiral against the RouterPlate. Mark the position of the RouterPlate:

   Just make a fine pencil line on the BasePlate at the left hand side of the RouterPlate about 1/2”~13mm from the front, it only need be 5mm or 1/4” long.

   On older black plates, you can scratch a line and etch it with typewriter correction fluid rubbed into the scratch.

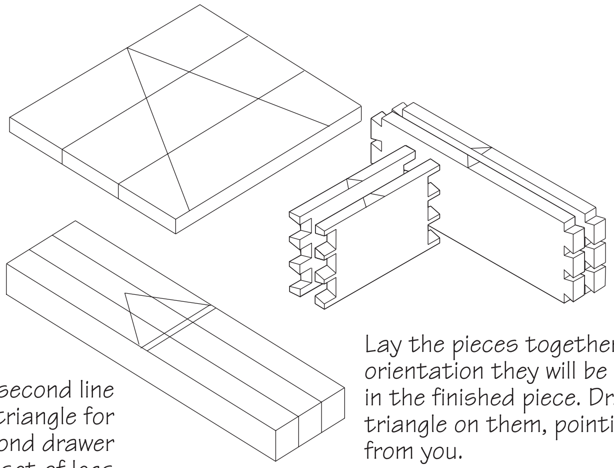
   Now when making Square Cuts, set the RouterPlate to that mark, bring the Spiral ‘in’ to the Plate. Fix it with its Star Knob. Now you can twist the RouterPlate against the spiral as you bring the router forward and it will cut at 90°.

Tip: When cutting square, it is possible to bring ‘in’ both spirals, but this is not recommended. It’s better to twist the RouterPlate against the left hand spiral as you bring it forward and keep the twist on as you push it back.

The stock

For the following exercise take two pairs of boards of unequal length. The longer will take the tails and will be the box sides, and the shorter will take the pins and become the ends.

Identifying the Boards



Make a second line in the triangle for the second drawer or set of legs

Lay the pieces together in the orientation they will be in when in the finished piece. Draw a triangle on them, pointing away from you.

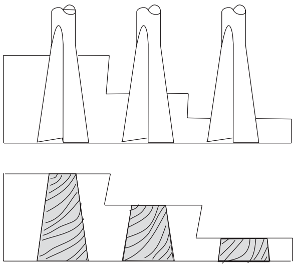
You will then be able to pick up any piece and tell where it comes from.

Having struggled with all kinds of uncertain methods, with A's and B's and corner marks to identify which board is which, I have found no better way than that recommended by Adrian C van Draanan in an article in Fine Woodworking *(reprinted in Boxes Carcasses and Drawers. Taunton Press).*

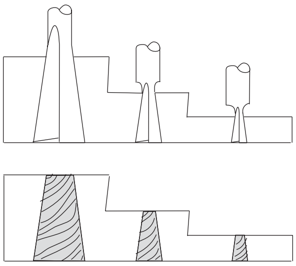
It uses pencilled triangles drawn on the face of the pieces as they are laid out in the position that they will ultimately lie in the finished work. The rule is that the triangles point away from the worker.

Selecting the right Cutters

Choosing a Dovetail Cutter



The same cutter in different stock thicknesses



Different cutters in different thicknesses of stock

Generally, you use the smallest possible bit longer than the depth of wood. Using an oversized bit will give a bigger pin, and be relatively less stressed in hard timber, but it will look clumsy and not at all WoodRat made.

Beware! *There are some dovetail bits with very wide angles (14°) that are intended for fitting rubber seals in window sections and other similar jobs. These are fine for sliding dovetails, but are not recommended for through or half-blind dovetails. They do not look right, the wide angle dovetails are not particularly strong, and you may not be able to configure the WoodRat to make the pins.*

Choosing a Straight Cutter

The rule for Through Dovetails is ‘the bigger the better’. However, the cutter must not be wider than the space between the sockets.

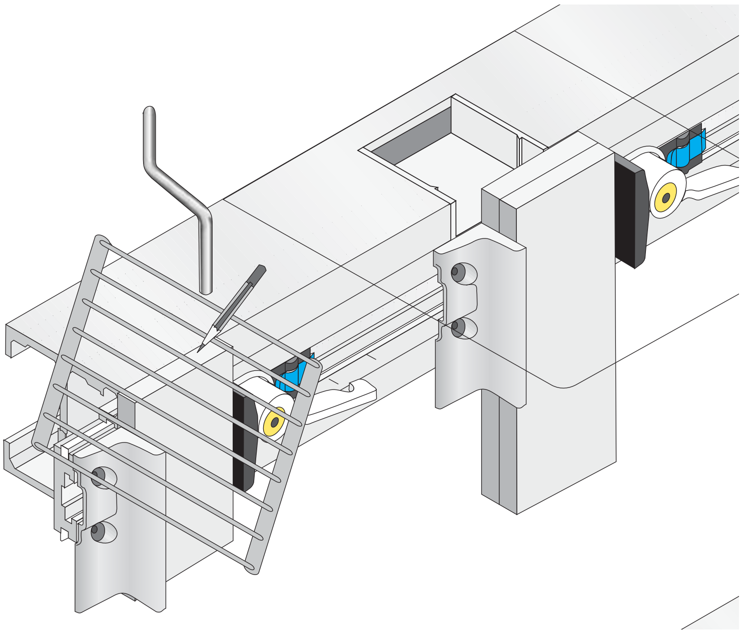
Marking The Pin Positions

Anyone who has spent hours marking up for dovetails will have thought to himself “there must be a quicker way”…well this is it.

1. Place one of the Ends in the Marker Position. This piece will later be cut with the pins, but now you mark it up with the pin positions that show where to put the dovetail sockets in the Sides.
2. Place both Sides in Cutter Position with their insides on the outside of the pair, so that any tearout will finally end up hidden inside the joint. They will be cut to make the Tails.

The Parallelogram

3. Swing the Parallelogram forward and mark up the End with a row of evenly spaced pin positions. Expand the bars so that one lies at each end and an evenly spaced set lie in between. You can see from the bars whether the spacing is right.



4. When making boxes with lids, or the backs of drawers the spacings will be different. Just place the bars as they are needed and make a pencil mark either side of each bar. These are the pin positions.

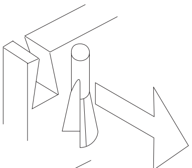
You will need to leave enough space-for the straight cutter to pass between the pin positions. So leave at least 15mm or over 1/2” between each position. If they are too tight, spread the bars to make fewer positions.

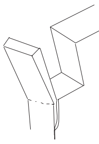
Remember, the marks don’t have to be perfectly placed. They just have to look right.

Cutting The Sockets

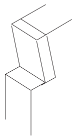
Now you are ready to cut the tail sockets. Cut dovetail sockets in the Sides, according to those pencil marks:

1. Track each marked Pin Position in turn in line with the Mark
2. Draw the router forward, cutting a Socket into the boards. Keep a gentle but firm twist on the Router Plate against the left-hand spiral.
3. Up-end the boards and cut the opposite end of the box Sides in the same way. These boards now become exact templates for cutting the pins.
4. Cut all the tails first, right throughout the project. There is then just one cutter change – to a straight bit – so that the Pins can be cut. There is no need to keep swapping bits between tails and pins as you have to on some dovetailers, because there are no settings to be lost. The cut board has become the template.





A cut, placed too near the edge, can cause a ragged edge



Remedy: First make a half cut to trim the edge, and then the full cut.

Warning - The First Tail Socket

You will readily see that if the first cut is made just within the edge of the board, the waste will break off and cause a ricket on the edge of the board. Avoid this by cutting the edge first, before placing the cut in the exact position. The same goes for the last socket. Cut clockwise round the board.

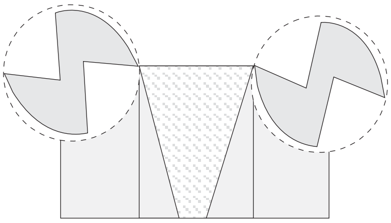
Now as each socket in the tail board is tracked to lie exactly opposite the Mark, the pin position is exactly placed in the board for the pins under the cutter ready to be cut.

The WoodRat will make a pin to fit any reasonable size and shape of dovetail socket cut by any make of dovetail bit. You cut it with a straight cutter. There are two things to get right on the WoodRat:

- The Position of the **Button -** (determined by using the chart on page 97, or by the method described later).
- The Positions of the **Spirals.**

Note: Settings for the Spirals are no longer taken from the chart (as shown in the video). Instead they are derived from the test stick. We explain this later.

What happens when we make a dovetail pin?



A dovetail pin is made by cutting two cuts with a Straight Cutter. The cuts come through the wood at angles, as on the branches of a Vee. The point of the Vee in this case is the centre of the Button on the Centre Plate.

The size of the pin depends on how far the button is away from the face of the WoodRat. That's the distance “d”.

The further away – the bigger the Pin will be. The closer to the face – the smaller the pin will be.

It will also depend on the diameter of the Straight Cutter and the diameter and the angle of the Dovetail Cutter used.

Set-up:

Before cutting the pins:

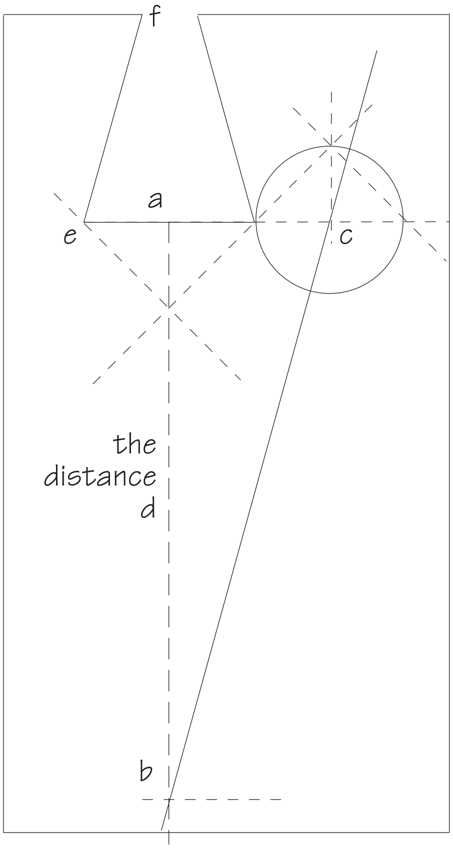
- Open out the Spirals. Now the Router Plate is free to swivel around the button, as well as pass forwards and back.

Warning: *Check that the Front Stop is in place so that the cutter cannot cut the Base Plate at any time.*

Setting the Spirals

1. Find your two test sticks. Place the thin one with the socket on the left hand side (in Marker Position) a little to the left of The Mark.

Finding the Button position to make a pin to fit any dovetail



Note that the triangle abc gives you the slope angle of the cutter: take the distance ac and see how many times it will go into the distance ab. If it goes 61/2 times, the cutter slope is 1 in 6.5 and the slope number is 6.5

To make a pin to fit any dovetail. Place the dovetail bit that you are going to use.

Take a scrap board and shoot the end square with it. Then re-set the board in the Cam Lock.

Drop the cutter to depth and cut a socket.

Take out the board and bisect the base of the socket with two angled lines (about 45°).

Draw the line ab square to the board top.

Place the straight cutter you're going to use on the board and exactly mark its width.

Bisect the straight cutter with two more 45° angled lines.

Set the bevel to the angle of the socket edge ef, and slide it across to the centre of the cutter at c and draw a line down to cross the centre line of the socket at b.

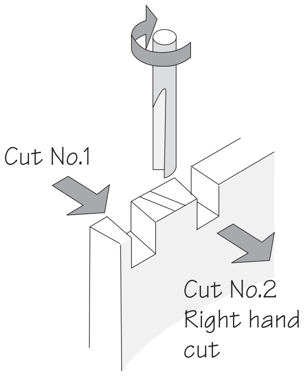
Measure the distance d with a rule. This is the distance to set the button on the centreplate (see the manual where we call it Setting the distance d). That sets the distance from the button to the back of the pin or the face of the machine.

Make the lines as accurately as you can, with a very sharp pencil or preferably using a knife.

Perfect Pin Cutting

Cutting the pins takes a little getting used to. The intention is to get a consistent sequence in an easy flowing action that cuts sharp, clean pins without tearout. You can use any sequence of cuts that you like but we have worked out the following and it seems to work well:

Cut #1



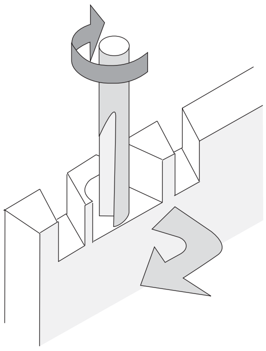
- Start at the left-hand edge of the board (Pin 1). Track the first socket against the Mark on the left.

Make a right-hand cut, (the position is right on the edge of the board so there is no left-hand cut here).

- Twist the router to the right and pull forward firmly but gently through the wood. Push the router back again keeping the same right hand twist, so that the edge of the Router Plate is kept against the left hand spiral throughout the action.
- Track the Tail Board to line up Tail Socket #2 against the Mark. this lines up Pin Position #2 under the cutter.

Cut #2 Make another right-hand cut… forward and back.

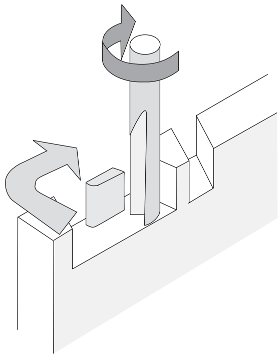
Cut #3 Then, without moving the bar, twist the router over to the left and pull forwards as a left hand cut. But don't push the router 'home'.



Note: *When cutting this cut, the Cutter might tend to bite into the pin, wandering away from the right-hand spiral. Do not let it do this. Be firm.*

If the pins are at all widely spaced there will be some waste between them, so:

- Track the board right, into the path of the cutter, to take out the waste. Go clockwise, cutting the front of the board until the previous slot from Pin #1 is reached.



- Push the router away, and cut the waste at the back between the pins, moving the board left. Clear the remaining waste if there is any, and then push the cutter 'home'.

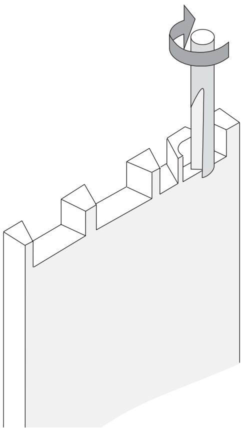
This describes a clockwise spiral cutting. Notice the direction of spin of the cutter (Clockwise as you look down on it). The cuts are all down-cuts, and there should be little break out.

When cutting the front of the board the feed will be to the right (clockwise). For cutting the back of the board, the board will need to be tracked left (clockwise again).

Cut #4

- Move the bar beyond the pin that you have just made, to Position 3. Cut a right…

Cut #5



The last pin has a left-hand cut only.

…and a left. Clear the waste back to Pin 2 as before. Push the router 'home'.

Then…

- Move to Position 4 and so on.

When all the pins are cut, try for a fit.

You may wish to fine tune the settings before continuing.

Then…

- Repeat for all four corners.

Avoiding Tearout

One Way

Fine grained hardwoods will give very little tearout, but if you are getting splinters as the cutter comes through the board, there is a simple remedy that takes less time than planing up the finished work. At each pin position, pre-cut the front of the board by cutting a right and a left -hand cut into the board from the front, and then clear to the left, across the board front between the pins. Push the cutter in just less than half a diameter. When you come round from behind the board to cut the pin, there will be nothing to break out, and the joint will be as clean as a whistle.

Another way:

Cut a right-hand cut half way into the wood coming from behind. Then, un-plunge, and hop the router over to the front of the board and push into the board to joint the cuts. This is easy with a PlungeBar.

Cleaning up

Tip: The more accurate the depthing, the less time is spent cleaning up after gluing up.

Dovetails and finger joints properly prepared and cut on the WoodRat can usually be glued together with only a little light clamping, but it's wise to make pins a whisker short so that the face stands slightly proud of the pins. When the box is clamped, there will be no damage to the pins and there is no need for those tedious cut-out clamping blocks. The sides are planed down to the pin ends and this removes any tearout.

Getting the depthing correct, therefore, means a welcome saving in cleaning-up time. It's well worthwhile getting good at depthing the bit and also, incidentally, shellacking the parts that you don't want glue stuck into, such as the inner faces of drawers.

Nesting the Marks

You can draw more than one Mark on the WoodRat face. A straight cutter's Mark can be marked up under the dovetail cutter's Mark. The Mark remains here as long as it is needed. It can be removed with a soft eraser and if other larger or smaller bits are used, their Marks can be nested with the first ones, or placed below them.

Tip: If pencil marks are difficult to remove, use a solvent (methylated spirit) to clean the area. Allow to dry and try again with a soft eraser.

Heavy Work

With its ability to dovetail 2” timber, the WoodRat is robust enough to make a log cabin. Heavy section timber is treated generally in the same way as smaller stuff, but greater attention to firmness is needed.

A 2 horsepower motor capable of taking a 1/2” shank cutter will handle boards up to 2” thick. For boards over 7/8” place one or more raising plates under the Base Plate, to gain greater depth of cut. Use the longer caphead screws to hold the Base plate.

If greater forward clearance is needed, bring the Base plate to Position3, (forward in its slots). When making big dovetails you will need to register the front line on the Centre Plate on the right hand silver scale on the Router Plate, when the Router Plate is brought forward onto the Front Stop. You then use the front cursor.

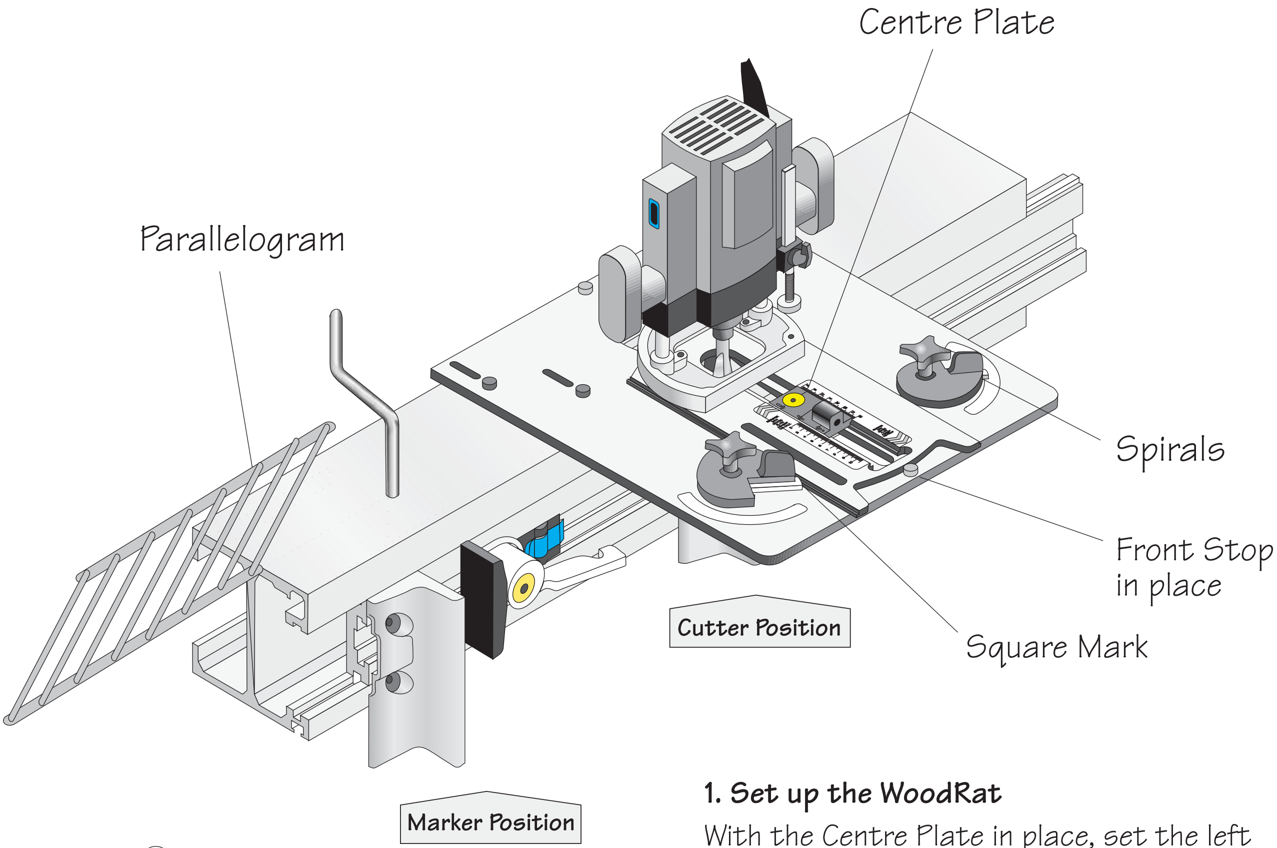
Extreme care must be taken for larger sections, especially in hardwood. Keep the bits very sharp, and if necessary take out waste in sections, a little at a time. leaving a final fine cut on the line and to the exact depth.

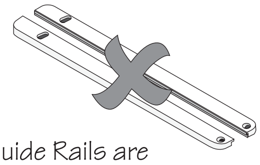
But, always cut dovetails in one pass.

The ability to work 2” timber is particularly useful when framing up 2”x3”s and 2”x4”s. The framework can be jointed and erected, and the secondary fixings can be done on it, (cross bracing and window fitting etc.) before it is finally knocked down and glued up, or screwed together.

Through Dovetails

Step-by-step

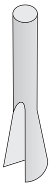




Guide Rails are removed.

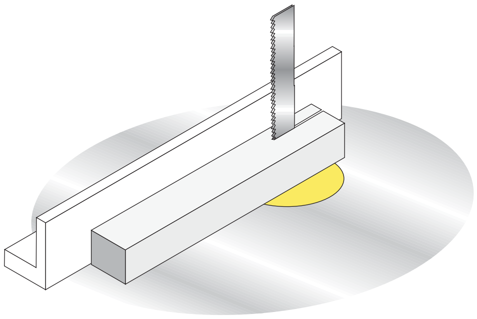
1. Set up the WoodRat

With the Centre Plate in place, set the left hand spiral so that the router will cut square.



2. Select the required Dovetail Bit

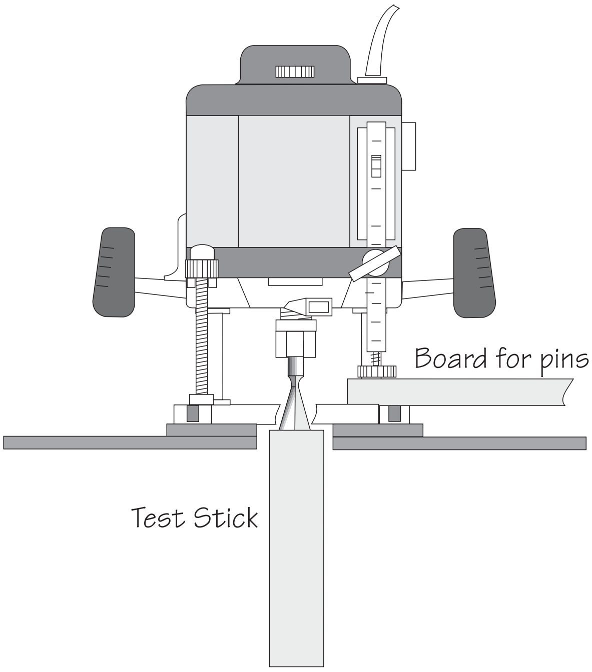
to the correct size for the boards to be joined.



3. The Test Sticks

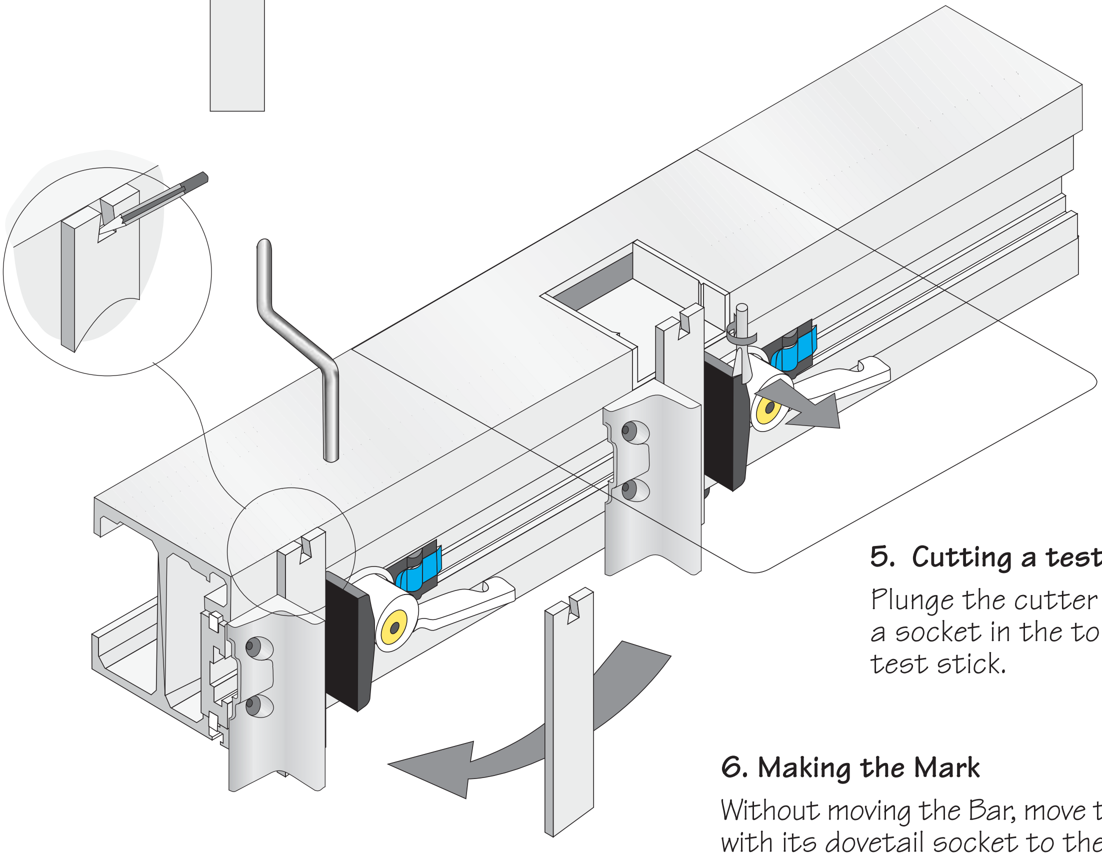
Make two test sticks, one thin and one thicker.

Place the thin one in cutter position and zero the cutter onto the top of it.



4. Depthing the Cutter

Zero the Dovetail Cutter onto the top of the stick. Use one of the boards for pins to depth the cutter with.

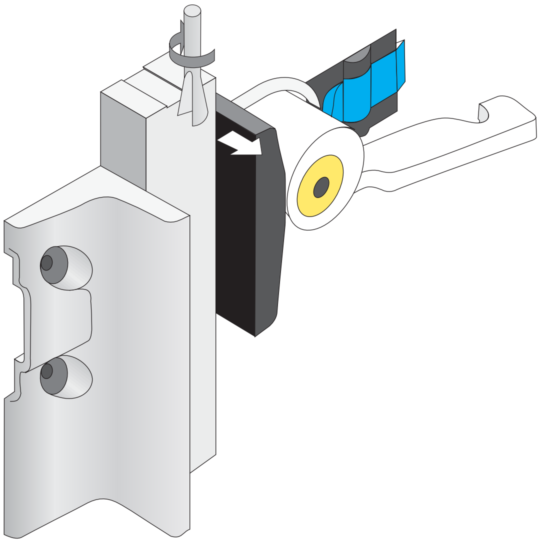


5. Cutting a test socket

Plunge the cutter and cut a socket in the top of the test stick.

6. Making the Mark

Without moving the Bar, move the stick with its dovetail socket to the Marker Position and draw the size and shape of the dovetail cutter onto the face of the WoodRat using the socket as a stencil. This makes **'the Mark'.** Note that the outside of the line represents the dovetail bit.

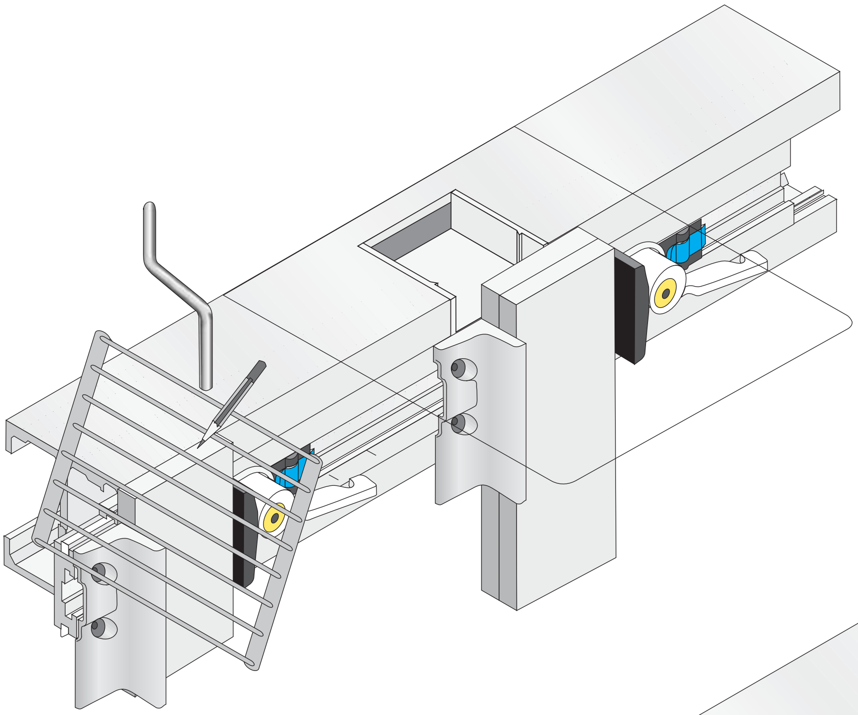


7. Cutting the Groove

Without moving the Bar, place the thicker test stick directly up under the cutter. Push the router away, Squeeze the Stick upward a fraction and Cam it in.

Switch on and bring the router forward to cut a shallow groove in the top of the stick

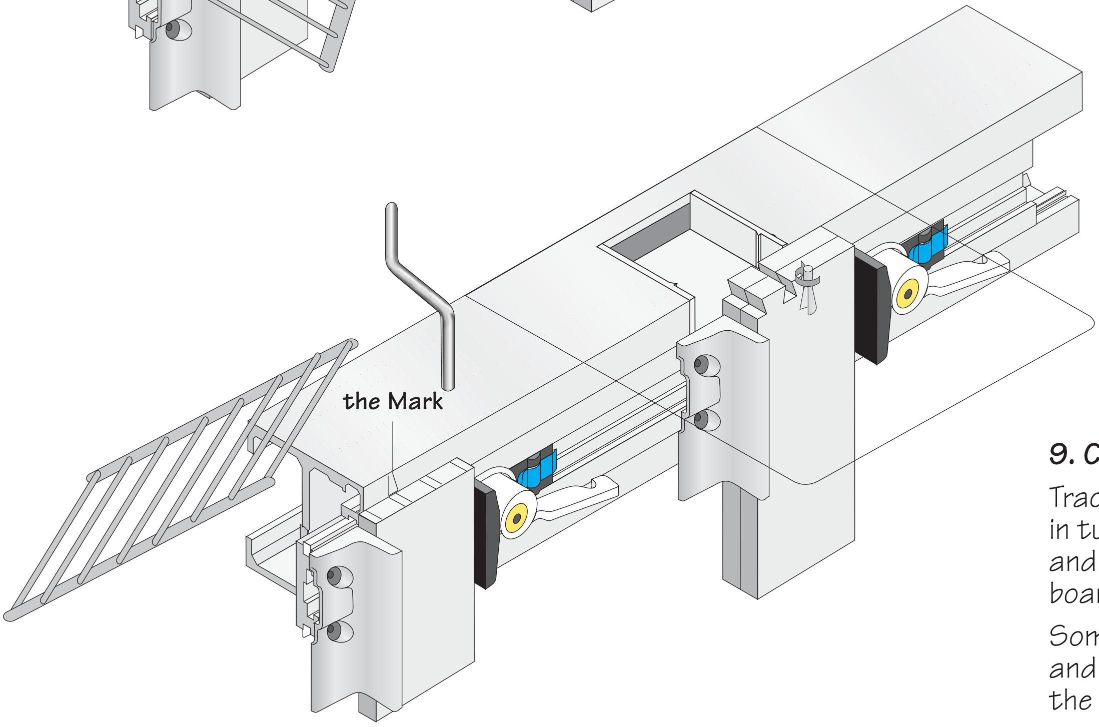
Mark the front face and put the two test sticks aside for the moment.



8. Marking out with the Parallelogram

Put both the tail pieces in the Cutter position and one of the pieces for pins into the Marker Position.

Use the parallelogram to mark even spaces across the board end.

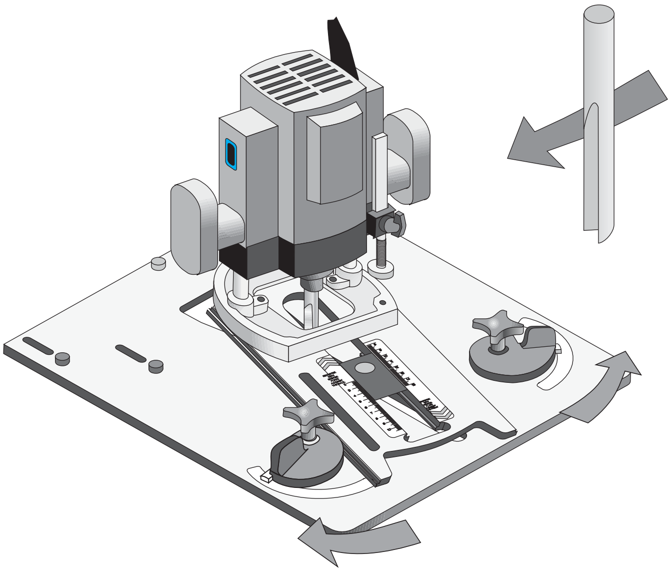


9. Cutting the Tails

Track each joint position in turn against **the Mark**, and cut sockets in the boards for tails.

Somersault the boards and cut the other end in the same way.

Cut all the tail sockets right through the job.



10. Set up for Pins

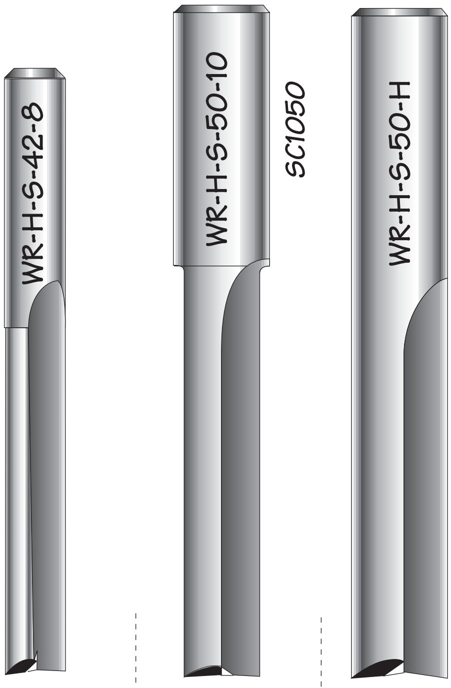
Now change the cutter for a straight cutter.

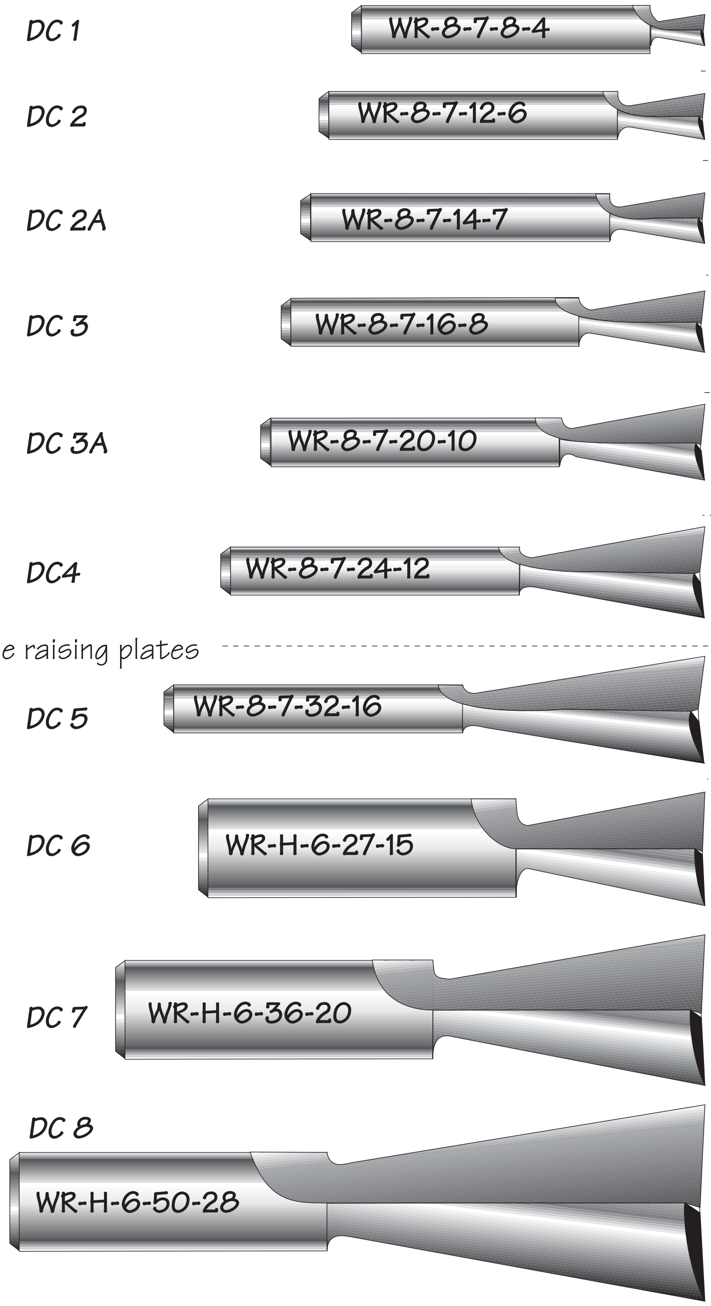
The straight bit must fit comfortably between the pins.

11. Place the Button and CentrePlate

When using **WoodRat cutters** read the button position off the chart
When using **other cutters,** calculate the button position.

Push the router back against the back stop and set the Button position.



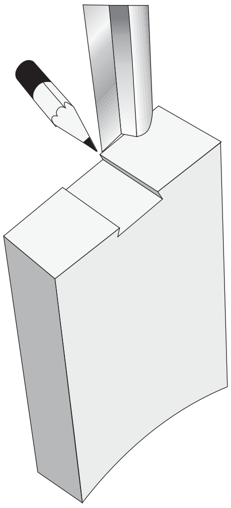


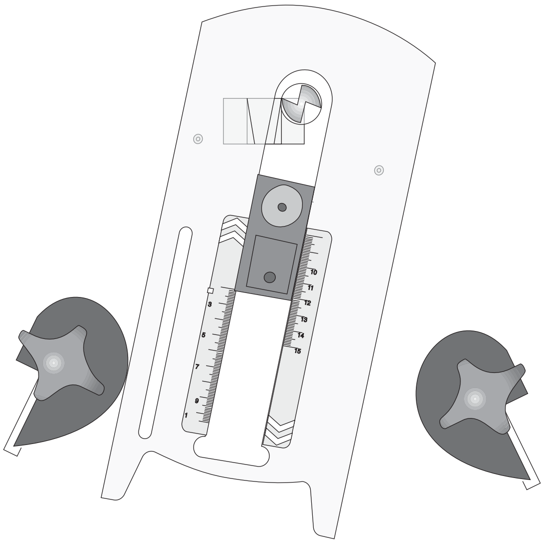
Former Reference No.	Current Reference No.		WR-H-S-42-8	WR-H-S-50-10 SC1050	WR-H-S-50-H SC1350
DC 1	WR-8-7-8-4	4	42	49	58.5
DC 2	WR-8-7-12-6	6	49	56	65.5
DC 2A	WR-8-7-14-7	7	52.5	59.5	69
DC 3	WR-8-7-16-8	8	56	63	72.5
DC 3A	WR-8-7-20-10	10	63	70	79.5
DC4	WR-8-7-24-12	12	70	77	86.5
Use raising plates					
DC 5	WR-8-7-32-16	16	84	91	105.5
DC 6	WR-H-6-27-15	15			84
DC 7	WR-H-6-36-20	20			101
DC 8	WR-H-6-50-28	26			117

12. Depth the Straight Cutter

Place the thin stick back on the left, and the stick with the groove under the cutter just as before, but raise the stick tight up under the Base Plate.

Zero the straight bit onto the top of the stick and depth it against one of the corresponding pieces with the tail sockets.

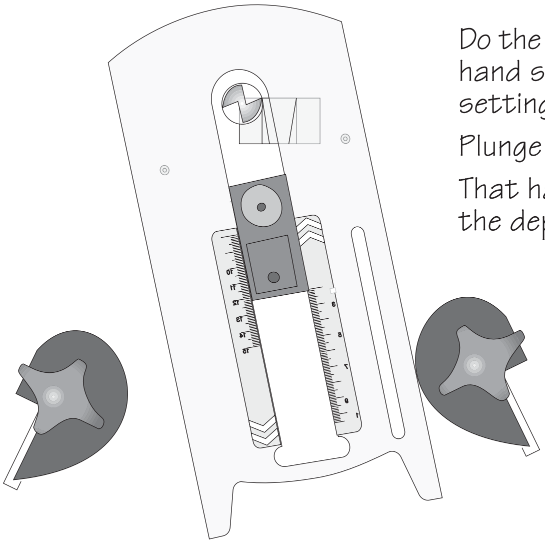




13. Setting the Spirals

Open out the Spirals to free the router.

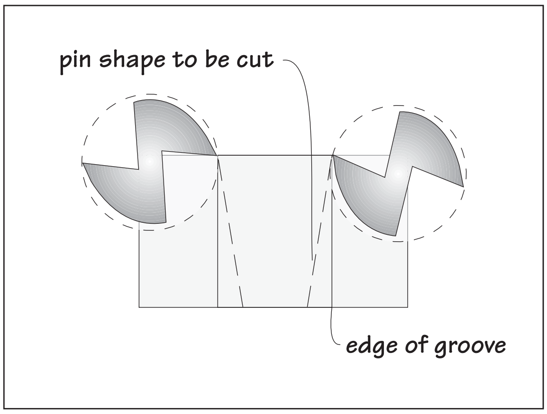
Swing the router bit against the edge of the groove on the left and set the right hand Spiral against the plate at the front. Tighten the StarKnob.

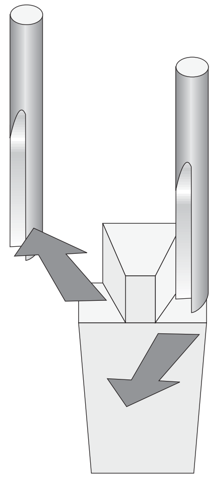


Do the same for other side, setting the left hand spiral. Don't worry if it's a different setting to the first Spiral.

Plunge the Router.

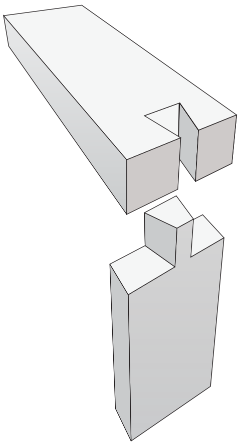
That has set the Button, the Spirals and the depth.





14. Cutting the Test Pin

Switch on and cut the test pin – a right hand and a left hand cut.



Check the fit and adjust as necessary by putting the Spirals in or out.

15. Cutting the Pins

Now place the piece with the tails in Marker Position

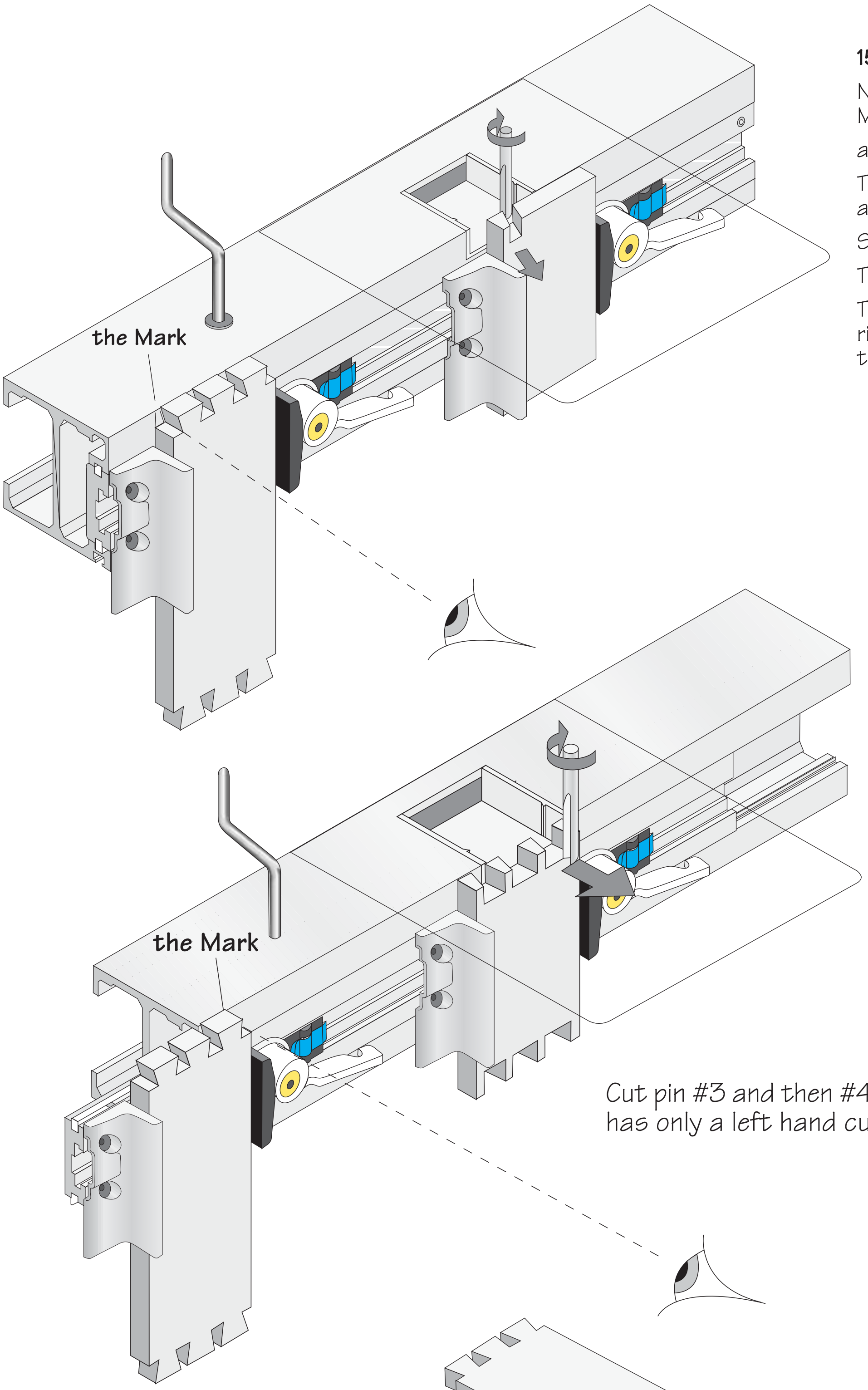
and the pin piece in Cutter Position.

Track each socket against **the Mark** and at each position cut a pin.

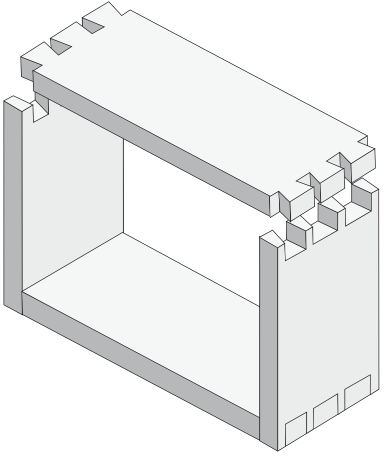
Start on the left of the board.

The first cut has only a right hand cut.

Track to the next position and cut a right hand cut and then a left, following the method shown on page 96.



Cut pin #3 and then #4 which has only a left hand cut.

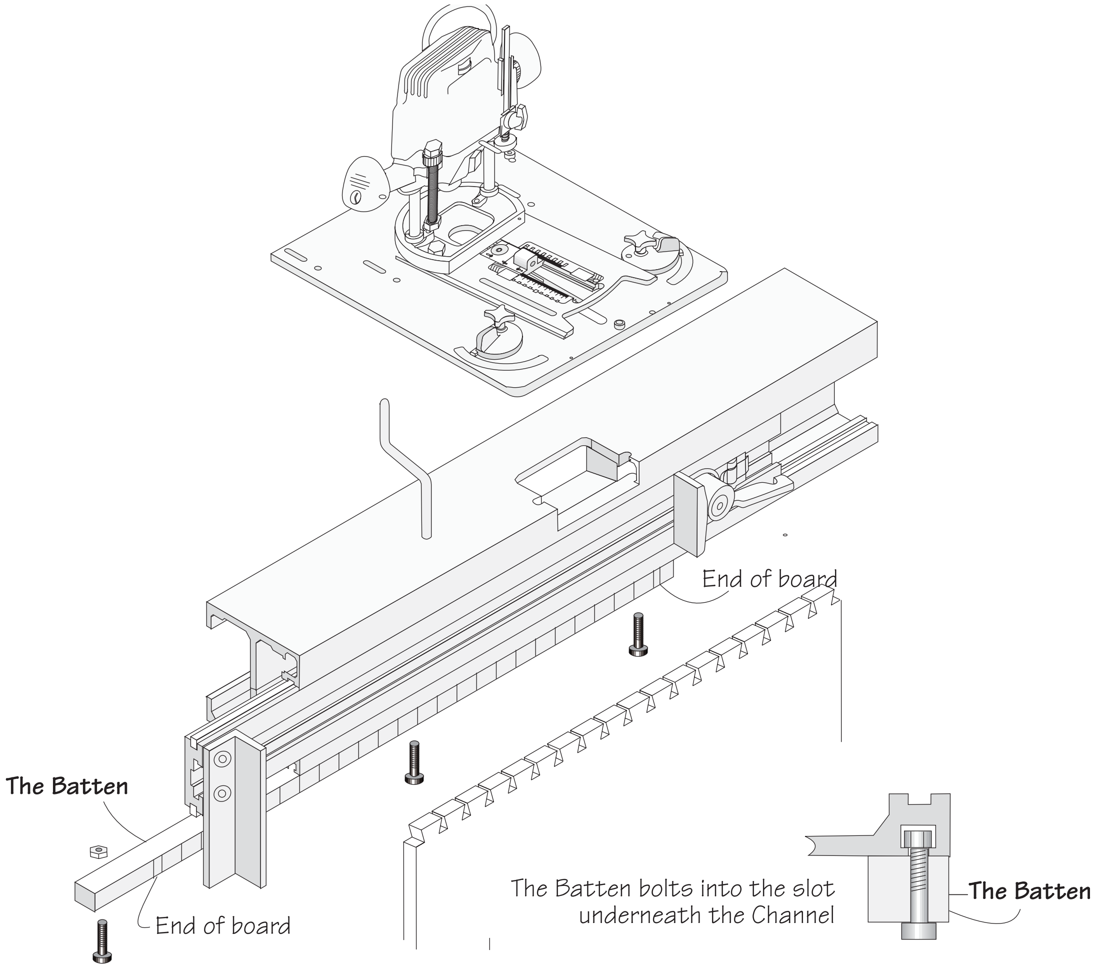


Those pins should fit the tails, just as the test pin fitted the test socket.

Dovetailing Wide Boards

When dovetailing work over 12” wide the Cam Locks are not wide enough to use the method of matching one board against another, you need something else to register against.

Unscrew the right-hand Cutter Fence and slide both the sliding fences out to the right. Slide the right hand one right out, if necessary and store it. Now you can clamp in a board just over 29” wide.



Set-up

A Batten, (described below) / Centre Plate and Spirals / Left-hand Cam Lock only

Stock

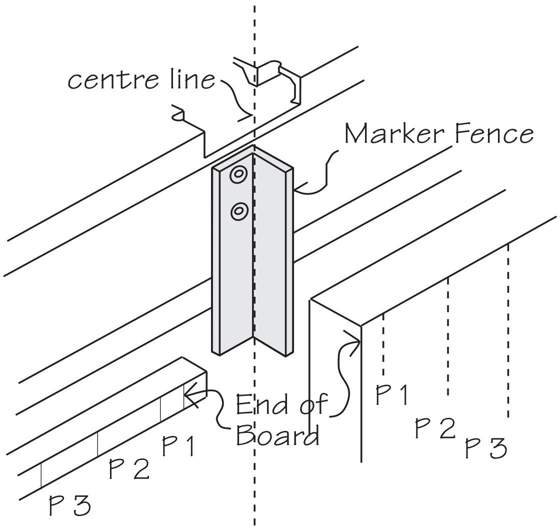
A ring of boards to dovetail as a chest or tool-box, (over 300mm, 12” wide). The longer pair for the sides and the shorter pair for the ends

Setting up the Batten

1. Make a batten in pale coloured wood (it will be pencilled on) 36”(914) long, that will fit up under the Channel. Section (25mm x 30mm)

2. Drill it with three 10 mm holes to loosely accommodate the two M8 30 Caphead screws. One at each end and one in the middle. You can keep The Batten and use it over again.
3. Place the caphead screws, put the nuts on, and slide the nuts into the tee slot on the underside of the Channel. The batten can now be tightened at any point, and can project to the left of the Channel end. Bring the batten forward to the back of the Fixed Fences before tightening the screws.
4. Place the batten so that the right hand end lies an inch or so right of the centreline of the router.

Set the depth of cut.



Make a test socket and pin and test the fit. The method is the same as for dovetails in narrower boards except that you do not make a Mark. Just make the socket at the correct depth in the first stick, and cut the groove in the top of the second stick without moving the Bar. Later, when you change to a straight bit, set the button and make a test pin, this groove will give you the size of the pin. You can place the cutter blades against the edges of the groove and set the spirals as detailed on page 97 and 98.

When the pin fits, make a note of the positions of the Button and Spirals.

Marking Out

Mark out the top surface of one of the Sides with the joint positions. You can use a traditional marking out method or maybe use the parallelogram to get even spacings.

Cutting Dovetails

1. Set the Router Plate and Spirals to cut square.
2. Put the two Sides of the box into the cutter position. Remember to hide the outside faces inside as before, to avoid tearout. Cut the first set of dovetails by sighting each joint position on the end of the board against the cutter and cut a socket at each position.
3. As you do this, draw a sharp but clear pencil line on the batten at each position, using the left-hand edge of the Fixed Fence as a marker.
4. Somersault the boards, and track them to each joint position in turn, where the edge of the Fixed Fence lies against the pencil marks. Cut a dovetail at each position. The two ends of the board will be identical.
5. Reconfigure the machine and set the button and the spirals. Check again that the pin fits the sockets in the wood you are using, not just the test piece.
6. Now place the corresponding End piece and track each position in turn, the edge of the Fixed Fence against the lines on the batten. Cut a pin at each position in the same way as for smaller dovetails.

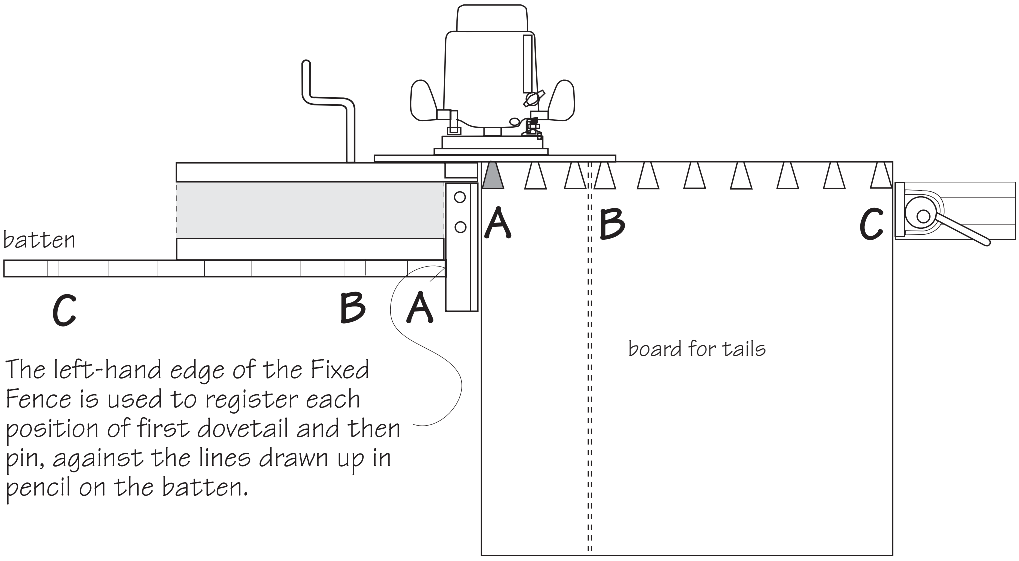
   Note that the cutter cuts each position along the board from A to B, starting from the left, but the Fence tracks across the batten from the right and goes left.

   It is as well to make a note of this on the batten and on the board. It becomes important later…

A Blanket Chest

Somersaults and Cartwheels

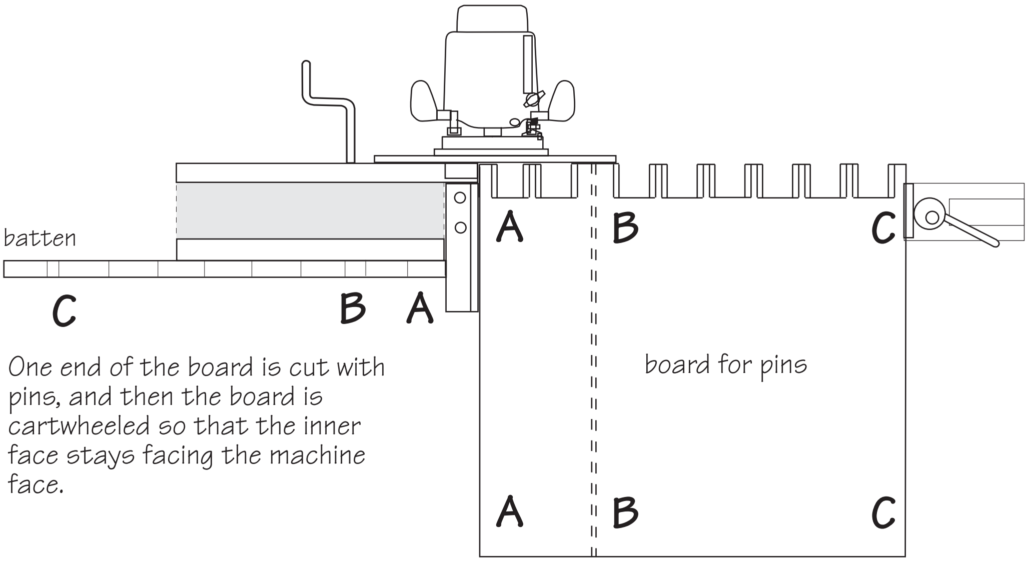
If you're making a simple chest with a row of evenly spaced dovetails and a flap lid, there's no problem. However, for a chest with a coffered or box lid, there is a problem because the spacing of the pins is complicated by having to accommodate the cut line.You have a different spacing at the point where the saw-cut will come.



The left-hand edge of the Fixed Fence is used to register each position of first dovetail and then pin, against the lines drawn up in pencil on the batten.

Cutting the tails is straightforward, the boards for the Sides can be somersaulted (not cartwheeled) as described, to cut the sockets on the opposite end from the marks on the batten.

Cutting the first row of pins on each board is straightforward too.



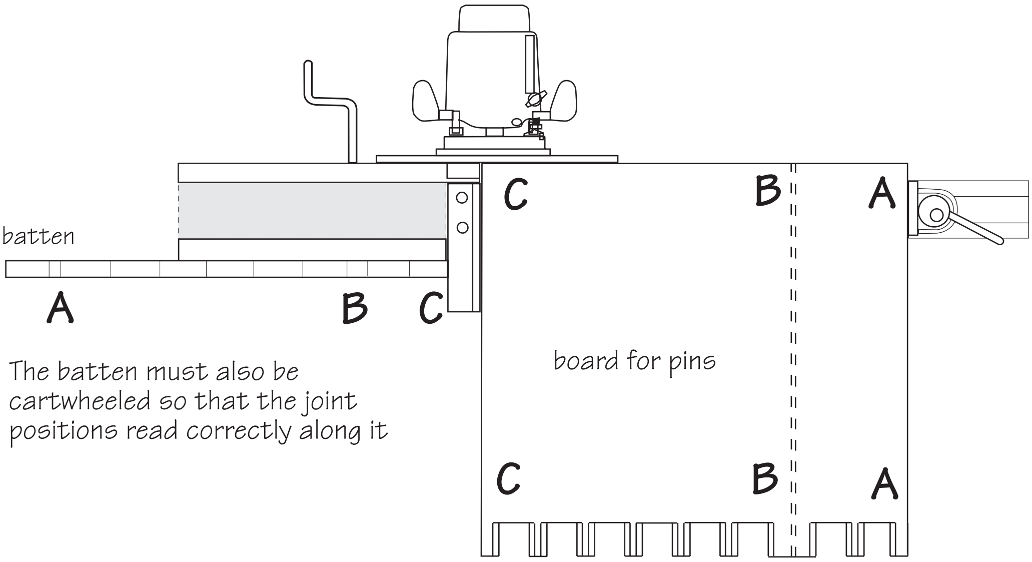
One end of the board is cut with pins, and then the board is cartwheeled so that the inner face stays facing the machine face.

But, the Ends have to be cartwheeled when cutting the second set of pins, to present the same (the inside) face to the face of the machine. They can't be somersaulted.

The reason for having three holes in the batten for the two caphead screws now becomes clear: just as the board is cartwheeled, the batten needs to be cartwheeled too. Without recognising this you will get the sequence wrong on one end or the other. It is worth marking the batten with A B and C, and the Boards likewise.

You will see that as the board travels right to left, the first cut at A on the board will be against a mark A on the right hand end of the batten.

Cuts at B in the middle of the board will be against a the B in the middle of the batten, and a cut at C on the right-hand end of the board will be against a the mark at C on the left hand end of the batten.



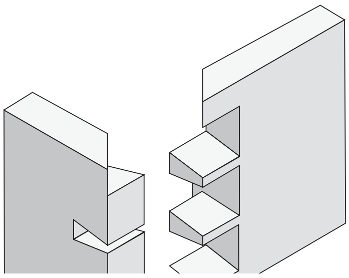
The batten must also be cartwheeled so that the joint positions read correctly along it

When the board is cartwheeled, the sequence is flipped too

The sequence of joints is now the wrong way round on the batten, so the batten has to be cartwheeled too and then the sequence is correct again, and the pencil marks can be used as before to locate the pin positions.

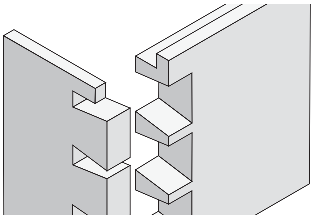
Dovetails for other occasions

Mitred Through Dovetail



A ring of dovetails presents a problem when you wish to rebate the edge to fit the box lid into the box carcase, and as usual any kind of decoration or profile that goes round the ring from one piece to the next requires a mitre.

Rebated Through Dovetail

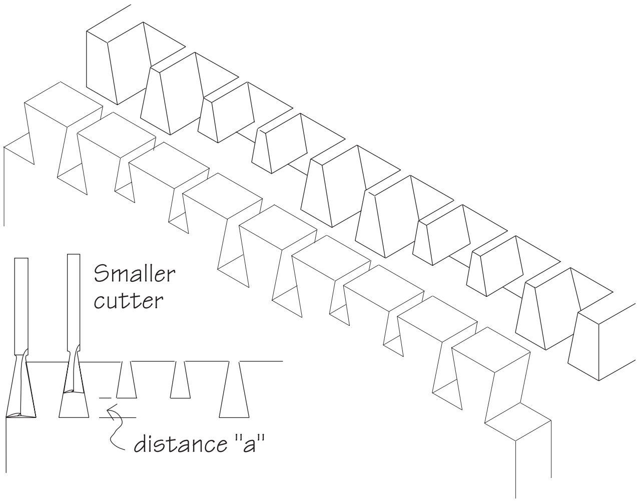


This is a companion joint to the last, but it is not mitred.

Instead of its being on the edge of the box side as it usually is, the socket is placed well away from the edge. When the rabbets are run, the one on the tails piece is squared off and shortened to fit the rabett.

Now you can rebate inside, but you cannot cut the outside of the ring without encountering end-grain.

Decorative Through Dovetails



Also called Cogged Dovetails

We think that this joint was first used by Ernest Gimson in a barrel vaulted coffer that he made in 1909. People have since interpreted it as having large and small dovetails in the same piece. Actually Gimson's joint comprises dovetails with square cogs between them, not small dovetails.

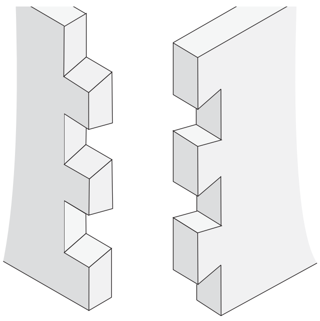
However, you can make them with dovetails relatively easily.

Set up: as for Dovetails

If you are using WoodRat dovetail bits, you will be able to match the smaller dovetails exactly with the larger ones.

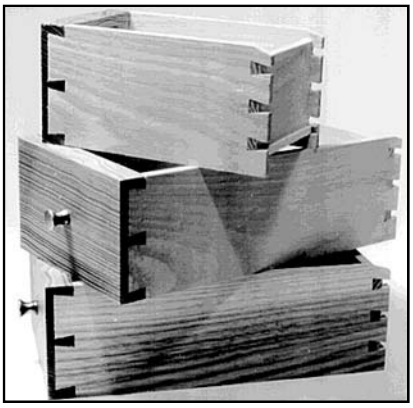
1. Having selected the two dovetail bits, make a Mark for the big bit.
2. Mark out the dovetail pin positions with the parallelogram.
3. Cut the larger tail sockets, depthing them to the full depth of the pin board.
4. Then place the smaller dovetail bit for the smaller pin sockets between them. Depth it so that it fits loosely into one of the larger sockets and raise the cutter gently until it just fits snugly, the smaller cutter housed inside the larger socket.
5. Now cut the rest of the smaller sockets at that depth.
6. Change to a straight bit. Set the depth with the depth-stop.
7. Cut the pins for all the pin positions in the usual way, first making a test pin if you need it, and setting button and spirals. Cut both the large pins and the small ones, because making the smaller pins is just a matter of cutting down the bases of each, at the correct depth.
8. Measure the distance between the bottom of the large sockets and the smaller ones. Mark up the end of the board with this distance (taken from the inside face of the board). Zero the cutter, and set the Allen key in the Centre Plate with the Star Knob, locating the cutter just to the line.
9. Depth the cutter, and cut all the bases of the small pins with the router brought forward against the Allen key. This should now fit.

Cistern Dovetail



The cistern dovetail is traditionally the dovetail for holding water or supporting lead lined vessels. The pin and the tail are made approximately the same size. The blunt look with the WoodRat is obtained by using a larger dovetail bit than you would normally use.

Section 9



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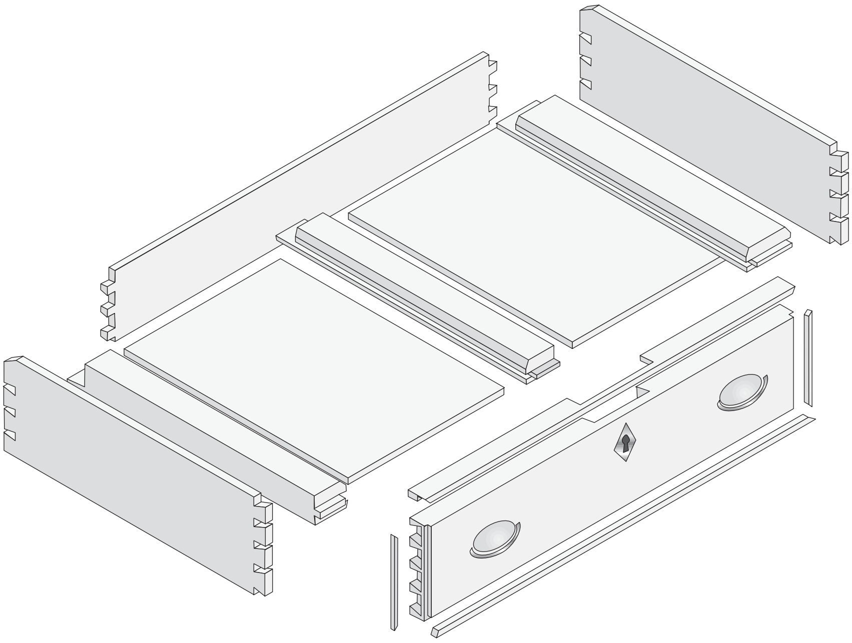
Mitred Dovetails 119

Drawer-Front Dovetails

Two ways to make drawer-front dovetails

There are many ways to make drawers fit their openings and to run smoothly and look good. If we explain how the WoodRat can make a classic drawer to fit its opening, then all the other ways can be worked from those techniques.

There are at least four ways to make the half-blind dovetails that joint the drawer sides into the Front of a drawer on the WoodRat.



Before you begin

Prepare your stock very square and sharp. The drawer Front is to fit the opening of the drawer carcase exactly, so the final fit of the drawer will depend firstly on the fit of the drawer front, and then on how much you need plane off to clean up the drawer.

Pay attention also to the ends of the drawer Sides as the squareness here determines the fit of the joint. The Sides musts be exactly the same height as the Front, and they should slide into the openings with a little friction. Make the drawer Backs exactly the same height as the Front and Sides; they will be cut down after the jointing process.

Mark out the drawers with triangular marks as for the through dovetails, so you don't get lost.

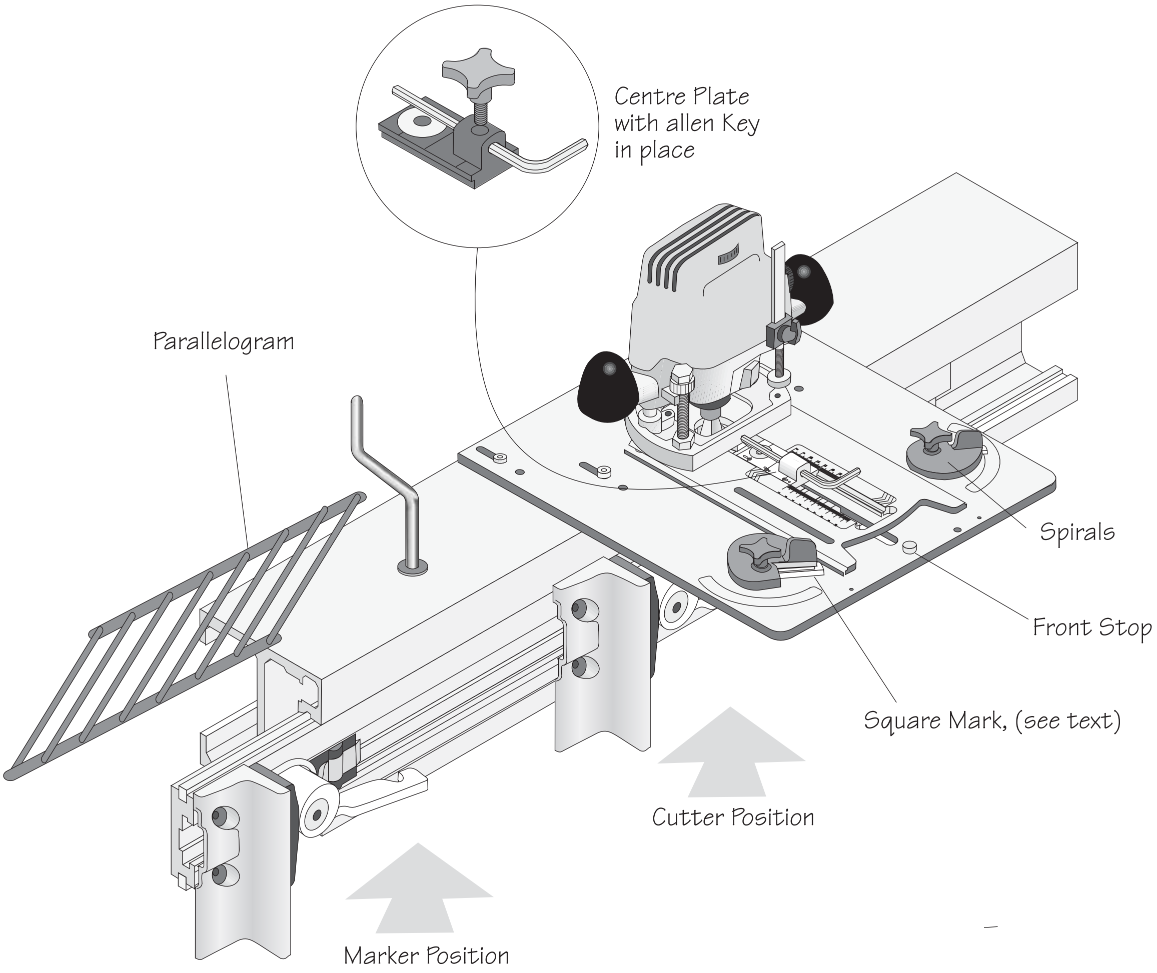
Making drawer-front dovetails with square shoulders

This is how to make a simple drawer in the manner of the English Arts and Crafts School

Set-up

Centre Plate, 6mm Allen Key, Spirals, Dovetail and Straight Cutters,

Parallelogram, Test Sticks (one thick one thin)



This way of making Half -blind Dovetails closely follows the method used for Through Dovetails. You make the pins fit the tails in the same way, using the thin and thick test sticks. The tails sockets are the same except in the depthing of the bit.

When it comes to making the pins in the drawer Front, the cutter makes the right and left angled cuts with the straight bit, but the cuts are stopped, and the space between the pins (the pocket) is cut away. The back of the pocket is made by tracking between the pins with the cutter held against a Stop.

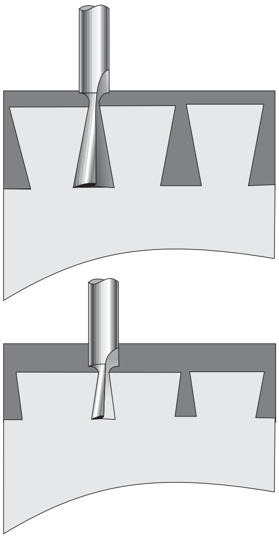
The cutter leaves rounded corners at the back of each pocket, so you must cut out the rounded back corners of the pocket with a sharp chisel to complete the dovetail shape.

It’s not difficult, because the sides of the pocket are well defined, and you can use them to position the chisel, but it takes care and a little time.

The benefit of the square shoulder is that you do get the full strength in the joint. You can use any cutter you wish – just as with through dovetails – at whatever spacing you need, and it needs very little setting up.

First decide on the dovetail bit to use.

Depth the Dovetail Sockets



In making through dovetails, the depth of the tails is given by the thickness of the corresponding piece – the piece with the pins. Here, it's a little different:

The drawer Front is usually made thick, (thick enough to take cock beading or fielding or decoration, and the end of the tail is lapped so that the end grain does not show on the drawer front). The cutter is depthed by placing it against the end of the Front and deciding on what depth looks right. Go to the full depth of the cutter for best effect if you can, choosing a smaller cutter if the larger one leaves too little for a lap. It's a matter of how it looks. It's your call!

- Set the dovetail bit depth against the drawer front held up under the plate behind the bit.
- Place the thin test stick and cut a socket in it, move it to the Marker Position on the left and draw the socket onto the face of the machine. Having made the Mark…
- Make the test stick groove in the larger test stick. then mark their front faces, and lay the sticks aside.
- Mark out the joint positions on one of the Back pieces in Marker Position using the parallelogram, as page 96.

Cut the tail Sockets

- Cut the tail sockets for the front of each Side piece.You can cut more than one Side at a time. Do them at least in pairs.

Tip: Put the outsides inside to protect them from tearout on the outer faces.

- Up-end the End piece on the left and mark out the joint positions for the drawer Back. They will be different because of the different condition at the back of the drawer . Upend the Sides on the right and cut again.

Tip: When making tails in drawers, make the back tails the same depth as the front. Then a) you don't have to keep remembering to change the depth between cutting front and back tails and b) there will be more tail to grip the drawer Back. The Backs can therefore be thinner and lighter.

Cutting the Pins

- When all the tails are done, through the entire job, change the cutter to the chosen straight cutter. This can be of smaller diameter than for through dovetails so that there is less to cut out of the pocket corners.

Finding the Button Position

- If you are using WoodRat cutters, take the button setting from the Chart, (page 139).
- If you are using another make of cutter of unknown slope angle, find the angle (page 94)

Cutting the Test Pin

- Replace the sticks and make the test pin in the thick stick following the procedure on page 93.

All this is exactly the same as for the through dovetail . But, when the thick Test Stick is in place, before cutting the pins…

- Depth the cutter against the drawer Sides, knowing that the face of the Sides should end up just proud of the pins so that you can clamp up the drawer lightly, yet not have a lot of planing up to do to fit the drawer. In other words, depth **very slightly** less than the drawer Side thickness.
- Complete the test pin.

When the settings are right…

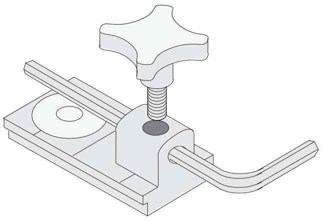
Dovetailing the Drawer Backs

- Joint the Backs with through dovetails as explained in page 91. This gives you a chance to fine tune the pins before making the drawer fronts.

Tip: Remember that the bottom cut of the bottom pin in each case is not cut until the grooves are made.

When the backs are all done, set the Allen Key Stop for the Fronts. Do not change the Button or the depth settings

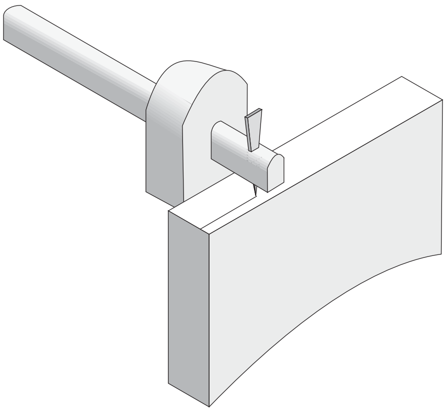
Stopping the cut

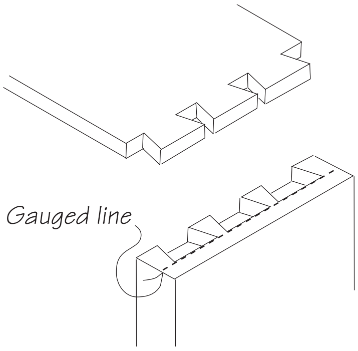


Take the 6mm Allen Key, and place it horizontally in the Stop Block on the Centre Plate.

Screw in the Star Knob, but don't tighten it on the key yet.

Depth of the Pocket





The depth of the pocket is given by the depth of the tail socket.

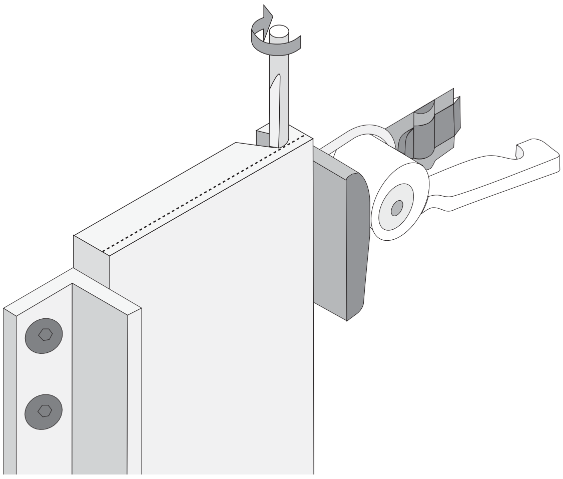
With a cutting gauge, set the depth from the end of the tail to the bottom of the socket.

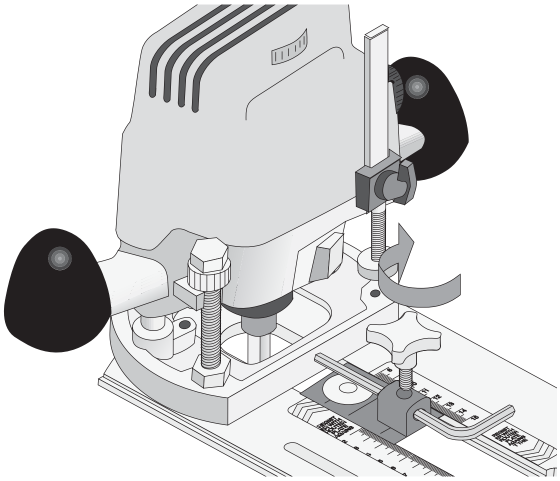
Using this, cut a gauged line in the ends of the Drawer Fronts, from the inside faces.

Note: *the inside faces of the drawer fronts must be as flat as you can make them or the line will not be straight.*

Being on the end, this cut line is plainly visible through the Router Plate when the Front is locked in in the Cam Lock and you are bringing the cutter forward.

Cut the Pins





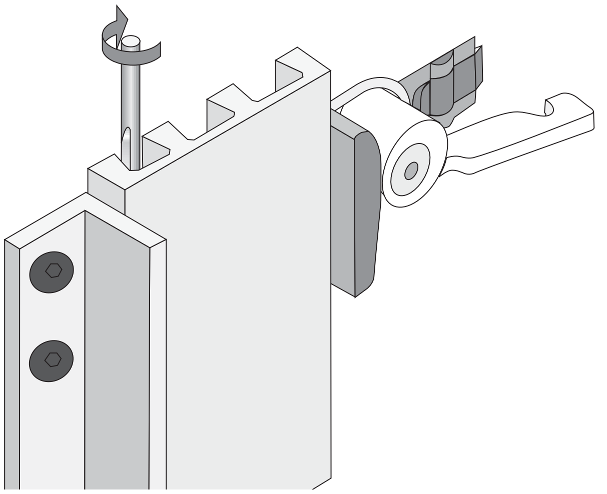
The sequence for cutting pins is the same as for through dovetails But…

- Cut the first right-hand cut a little on the waste side of the first pin position
- As the cutter approaches the gauged line, tighten the Star Knob on the Allen Key, (which must now be touching the router's Base). This will stop the cutter coming further forward.

How close you come to the line is up to you, but the closer you get, the less there is to clear out with the chisel later. So my advice is – very close – on the line but not over it.

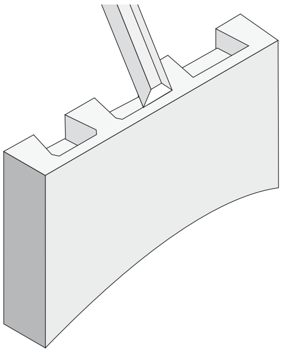
Tip: It’s better to use a cut line rather than a pencil line, because as you approach the line with the cutter, you can see a sudden change in the rounded end of the cutter path as it hits the cut line. This tells you when to tighten the Star knob.

Later, the line will guide the chisel to clean up the back of the pin pockets.



- Cut all the pins exactly as you would for through dovetails

Cutting out the Corners



Cleaning out the rounded corners of the pin pocket is less of a chore if you:

- Stack the pieces in the Vice and batch the process a bit.
- Step them with one rising behind the other in steps. You can cut them without having to put each one in the vise separately, and the one behind will protect the one in front so that you can apply more force to the cut.

It will also go faster with angled chisels to cut the corners. These can be made from old chisels ground to the dovetail angle.

Making drawer-front dovetails with rounded shoulders

It's perfectly possible to make good half -blind dovetails the round shoulder way using the WoodRat. Indeed, there are advantages to this method:

Firstly, it's quite easy, and partly follows the established method used by the simple one to one jigs, so if you have used an ordinary jig, this won't seem so different.

Secondly it's quite fast, once you have the set-up established.

Thirdly it avoids cutting out any round corners in the pockets. The tails have their corners angled off to fit the rounded corners – which is a lot quicker.

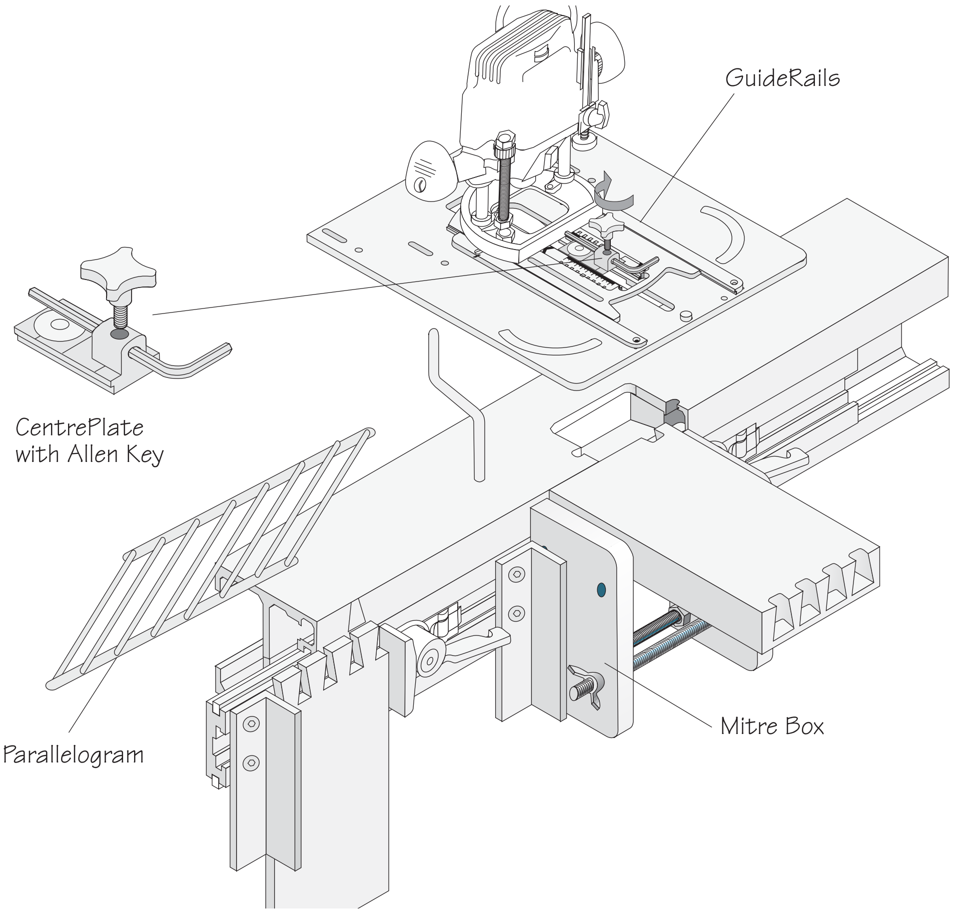
Fourthly it lends itself to batch production, So you can mass produce small drawers with elegant fine dovetails that are like the finest hand-cut work. Because of this we describe two ways of making the tails - for small quantities and for batch production, and a way of speeding the process of making the pin pockets.

Warning: *You cannot use the very fine 1-in-9 drawer-front dovetail bits for the round shoulder method, as they are not designed for cutting into end grain.*

Set up:

Centre Plate
Allen Key
Parallelogram

Mitre Box
Star Knob
Thin Test Stick



All the cuts are at 90° so set up the WoodRat using the Guide Rails throughout.

Preparation of stock

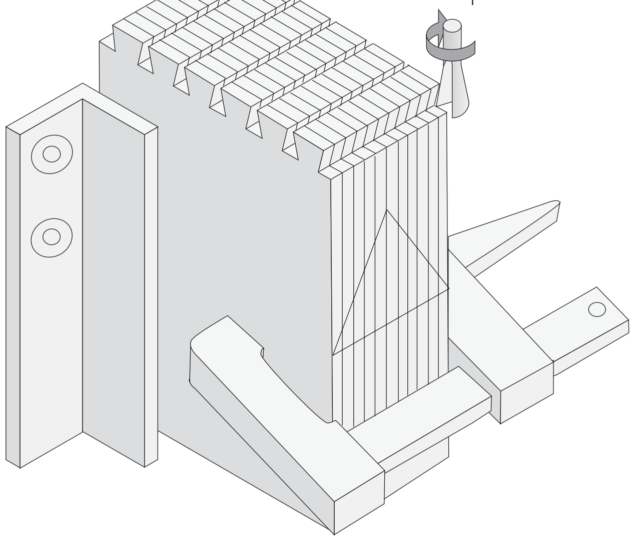
- Prepare your stock in the usual way – clean and square. Make the Front pieces fit the drawer openings exactly.

Depthing the Cutter

- Depth the cutter giving maximum depth of cutter yet with a good lap. The same cutter is used for tails and pins, and at the same depth. So make sure that the depthing rod is secure; then you can plunge and un-plunge the router as you need to.

  There are two ways to make the tails:

Making the tails



The stack of pieces is clamped together and passed through the cutter as one piece.

Do small numbers of drawers in the usual way:

- Make the thin test stick and cut a socket in it. Place it in Marker Position to make the Mark.
- Cam in the drawer Sides in pairs, and cut sockets at pin positions given by lining up the marks pencilled on the drawer Back against the Mark in the usual way.

If you have a lot of drawers to make it may be as well to do the whole lot in one tracking. Make two extra sides and use them on the outside of the block

Tip: *Use the triangle method to mark out the top side, and also which is the left and which is the right side of the drawer. Half of the pieces will be right side and half left, as indicated by the triangles.*

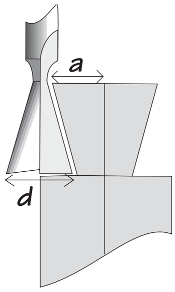
Dovetailing the drawer Backs

Dovetail the backs with through dovetails as described earlier (page 91). Remember not to cut the bottom cut of the bottom dovetail!

If you have a lot to do, consider making the backs with the angled stack method on page 129.

Shaping the Tails for the front dovetails

As discussed earlier, the back of the tail has to be profiled at an angle, to accommodate the back of the pin pocket, which will later be cut with a dovetail bit. Tails are shaped with two procedures:



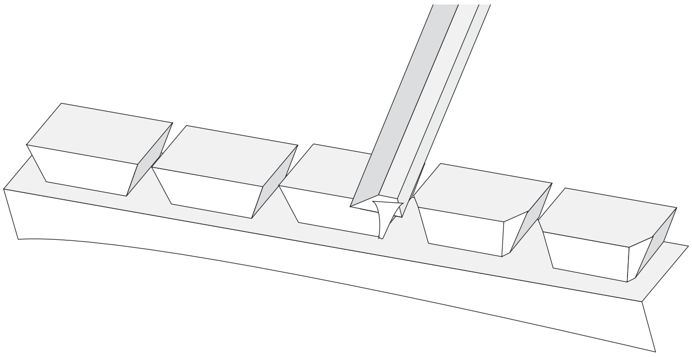
'a' is less than 'd'

- Run each drawer side past the cutter so that each front tail is rebated with a sloping rebate.

Tip: Keep the two pieces together back to back, as you run the pieces past the bit. This keeps the pair together and adds rigidity. You can put the pair in the Cam Lock and track them through, or you can run them through by hand, pressed up against the plate.

Note: *The depth of this rebate will determine how much tail is left to be housed in the pin pocket. It should be such that it will leave a thickness of tail ideally just less than the diameter* of the dovetail bit. The reason will become evident later.

There is no worry about tearout because the corners of the tails will have to be chamfered anyway…



- Take off each of the inside corners of each tail with a chisel and clean up with a paring knife (rounding them is not necessary) so that the tails will fit into the pin pockets which will have rounded corners when they're made – which is next.

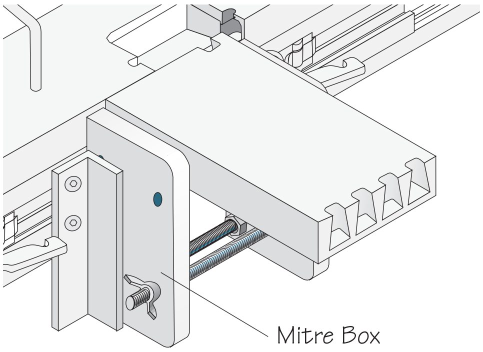
Important: *Half are undercut as left drawer sides, and half for the right sides. That's why you mark them with triangle markings.*

Note: *Leave the extra spare one of each side un-trimmed so that it can be used as a template.*

Mark one up as the left and the other as the right template.

Making the Pins for the Drawer Front

The drawer front is now held horizontally in the WoodRat under the Plate.



Set up: Use the Mitre Box for this.

Do not change the depth of the cutter.

Keep the Guide Rails in place.

The Centre Plate with the Star knob and Allen Key assembly is used to stop the cut.

Resetting the Mark

Now you're working with the the workpiece in the Mitre Box, the distance between your two fences has got bigger by the thickness of the Mitre Box cheek. You therefore need a new position for the Mark .

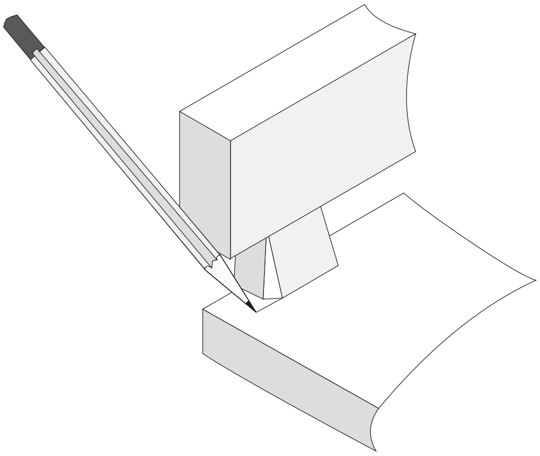
1. Place the test stick into the Mitre Box. It might be a bit awkward to get into the confined space.

2. Cut a socket with the dovetail bit, and cam it in on the left in Marker Position. Notice that The Mark is now to the left of any previous Mark.

3. Give it a distinctive sign, so that it doesn't get muddled with any other marks.

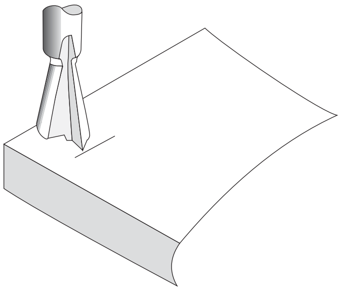
4. Place the drawer Front (inside facing up) in the Mitre Box with, say, the left hand end ready to be cut. Place the left-hand drawer Side Template in the Marker Position with the inside face facing away from you.

Mark up the drawer front:

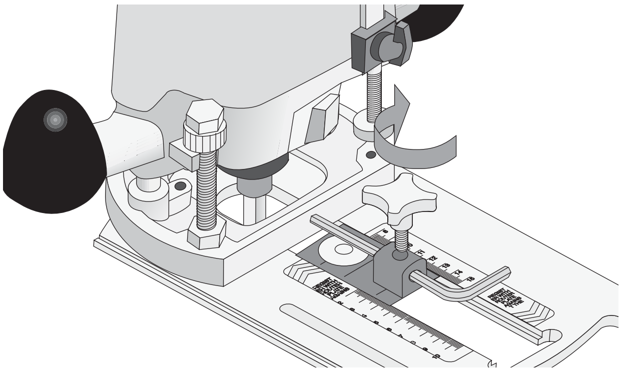


- Track the Mitre Box away from under the Base Plate and stand a drawer side on the top of the drawer front.
- Line up the outside edge of the tails with the drawer end.
- Mark the inside edge of the tail with a pencil line.
- Track the Front back under the Plate.

Setting the Allen Key Stop

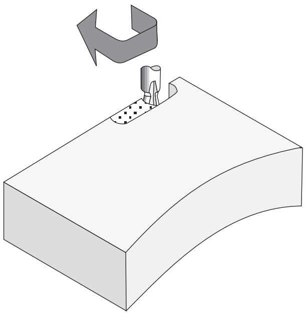


1. Bring the router forward over the board, with the blades north-south until the tip of the blade is at the pencil line.



The distance that the router comes forward is controlled by an Allen Key placed in the block on the Centre Plate and fixed with a Star Knob. The key simply hits the front of the router base and stops it coming any further forward. So…

2. Push the Allen key gently to hit the front of the router base, and tighten the Star Knob to set the Stop.



Now when the bit is plunged and the cutter cuts, it will come forward so that the socket will be as deep as the tail is thick, and hopefully the back point of the blade will cut the outer edge of the board at the same time.

Then, as the wood is tracked sideways, there will be a clean cut on the outside face, and the whole pocket can be cut in one action: in – along – out. This is quick and neat.

The procedure is as follows:

Cutting the Pin Pockets

1. Depth the router again.

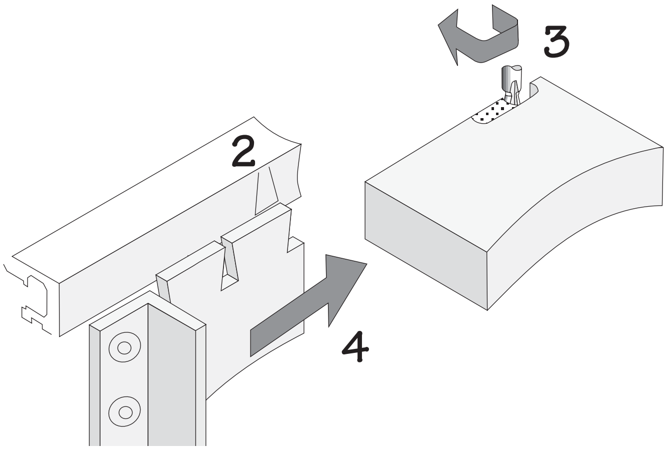
On the left:

Unlike the way we normally recommend you to cut, it's now best to work from right to left across the end of the board. This is kind of clockwise.

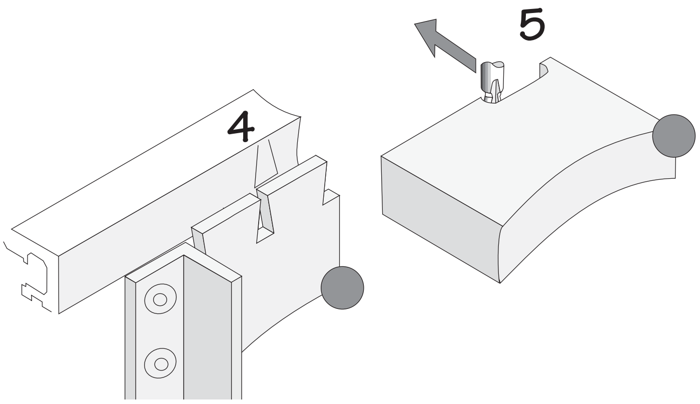
2. Line up the right hand end of the right hand tail against the Mark in marker position.

On the right:

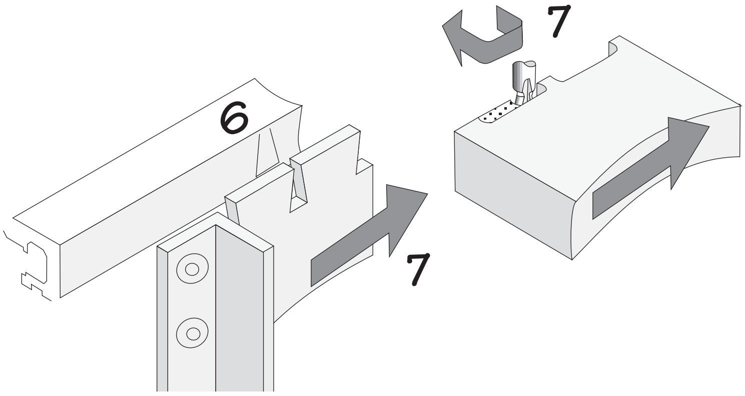
3. Pull the cutter forward into the drawer front until stopped by the Allen Key.



4. Track the board right, the cutter cutting the pocket, until the tail reaches the left hand edge of the Mark. Do this carefully by eye.



5. At that point stop and push the router away. That will be the first pocket, corresponding to the first tail.



6. Track the boards along until the right-hand corner of the Mark is opposite the right-hand edge of the second tail.

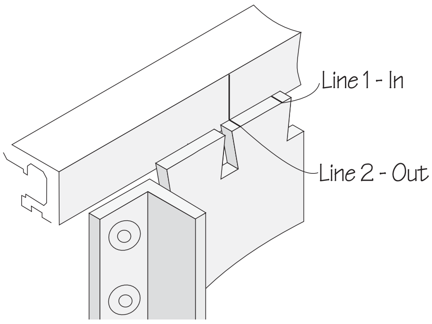
7. Pull the router forward to the Stop and then track the boards right. The cutter cuts until the Mark reaches the left-hand corner of the tail. Push the router away.

8. The second pocket is done. Line up tail No.3 if there is one (there is only two in the drawing above) and continue in the same way until all are done.

Now you can see the logic behind the depthing of the tail rebate, described earlier. The cutter is buried in the pocket as it cuts, with the near blade of the cutter cutting the back of the pocket, and the further blade cutting the free outside edge. The cutter is cutting the outer edge at the same time as the back of the pocket. It's all done in one action: In, track across, and out.

9. Un-Cam the pieces and try for fit.

Greater Speed



As the work progresses it might be as well to speed the process a bit with a more easily read cursor. Instead of the tail going against the picture of the tail it would be better to have two coinciding lines.

- Place a line down the middle of the Mark as a centreline of the position.
- As you line up and make each cut, put a pencil mark on the top of the template, opposite the line. Check that the fit given by those positions is good. If it is, continue the lines across the top of the template. Now you can use the lines on the template lined up with the centreline instead of the tails opposite the Mark itself.

Finishing the Drawer

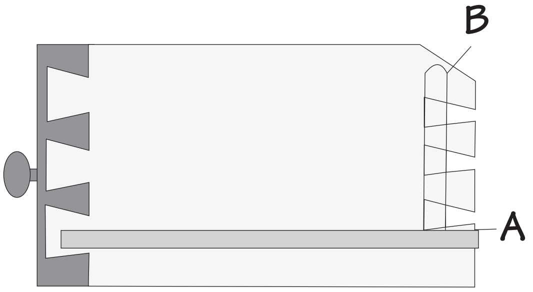
When all the joints are cut…

- Check that each ring of pieces goes together without misalignment. Clamp a sample of the rings to see whether it would be useful to plane down the drawer Sides a little at this stage. It is easier to plane them now than when they are assembled as drawers. The backs will not fit the sides yet.

Making The Groove

- Reconfigure the WoodRat, placing the Block in the Cutter Position.
- Place a straight bit for the groove to take the drawer bottom. Depth it.
- Groove all four pieces of the drawer ring. If you are using slips, groove the slips to the same setting. See page 47 Grooving.
- Pass the back through a second time, grooving the outside face. The bottom piece will be cut off and planed down, to allow the drawer bottom to be slid into place.

Now you can make the drawer bottoms exactly to size.



- Thickness the drawer bottoms as necessary, (page 46 and fit them).
- With a sharp chisel, cut off the triangular slip at A, (now you can see why you should not cut the bottom cut of the bottom dovetail pin).
- Plane off the bottom of the back.
- Reduce the height of the Backs and round them off (B).
- The Back should now fit the Sides.
- Glue up the ring and lightly clamp together.
- Now you can fit the drawer bottom, and mark the position for the screw to hold it to the back.

  If you are using solid wood for the bottom, there should be a slot to allow for moisture movement. You can set this tricky job up with a short forward travel of the router between two marks. Select a cutter the size of the screw shank width, plunge to depth and bring the router forward to make the slot.
- Finally chamfer the top of the sides so that the drawer will fit more easily into the drawer opening

Planing Drawer and Box Sides

One problem for which there seems to be no easy solution, is that of how to support the sides of a box or drawer as you plane them to finish them after gluing. The pins in the drawer ends are made slightly short, so that the sides stand slightly proud, so the drawer side needs to be planed down to the ends of the pins.

If you place the box on the workbench to plane it, the middle of the side bends down under the weight of the plane, avoiding the blade. Also the push of the plane distorts the newly made box – another solution is needed.

What is needed is a support under the box side that you’re planing, along its full length. The box can be hung on this projection like a shirt on an ironing board, with the front piece held in the vice. The supporting board needs to fit well and be quite flat and firm. MDF is ideal.

Mitred Dovetails

Where this joint really scores is when heavy decoration is taken round the corner from one face to the next. The strength of the joint is intact but there is no end-grain to get in the way of the decorative scheme. It is also recommended under veneering.

Fortunately, it is easier to make than it looks.

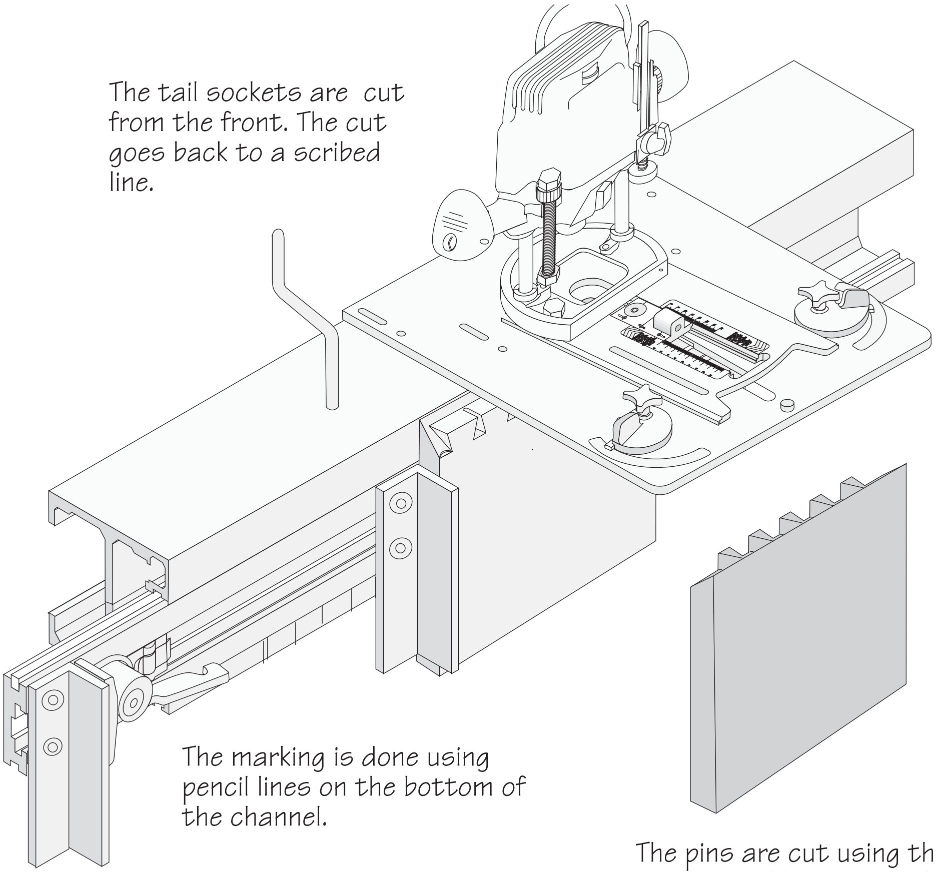
Set Up

Spirals and Centre plate, (6mm Allen Key in place).

Dovetail and Straight cutters

Mitre Box

Parallelogram



The tail sockets are cut from the front. The cut goes back to a scribed line.

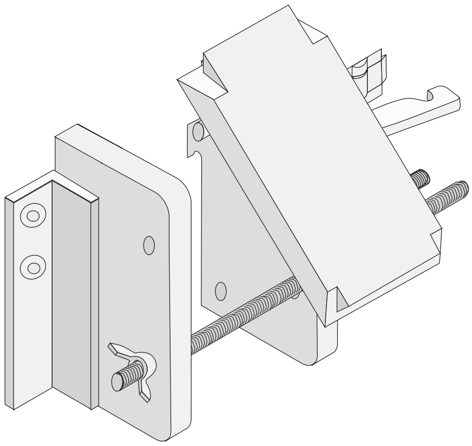
The marking is done using pencil lines on the bottom of the channel.

The pins are cut using the same pencil lines at each pin position.

Mitred dovetails hidden, so they can be quite sturdy and evenly spaced.

First make the mitred corner that the dovetails can fit into.

Making the Mitred Corner with The Mitre Box

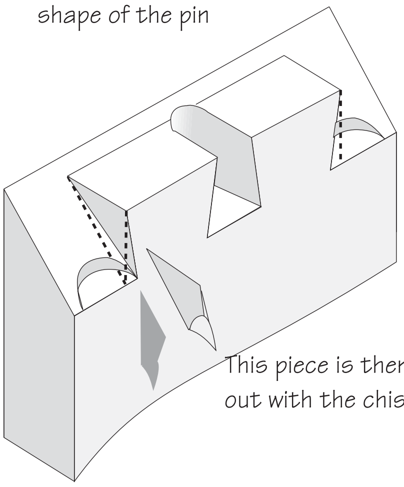


- Cut the 45° angle using a straight cutter. Cut clockwise along the left-hand edge, cut the back corner by fixing down the Router Plate.
- Release the plate, and the right-hand edge. This creates the mitre in which the joint is made.

Repeat for all the corners.

- Take out the Mitre Box and store.
- Place the wood vertical and rebate the end of the board. At this point you can determine how much lap you need for the joint.

Tails and Pins



For the outer tails, the sockets are cut as just a half circle, giving the size, position and shape of the pin

This piece is then taken out with the chisel

Mitre Dovetails are made in the same way as through dovetails with two test sticks, a Mark made with the first thin stick and a groove cut in the top of the second thicker stick. These, and the chart give the settings for the Button setting and the Spirals.

All this is explained on page 97.

Because both tails and pins are lapped, you cannot read the pin positions from the tails using the tail board as a template. Also, the tails need to be cut from the front.

This is no problem if you use the technique outlined in the section on using the Batten. Page 103 etc. Short runs of tails can be marked onto the machine face. Longer runs can be marked onto a batten placed under the Channel.

- Mark out the tail board with pencilled positions. Cut the tails, from the front, at these positions, but at each cut draw a fine line against the Fixed Fence onto the face of the machine.

Be careful not to cut too far into the back of the workpiece. You can see your cut, but it might be as well to mark the back position of the travel.

Note: *The outer two sockets are cut only half way in; ie. the depth of half the socket. This gives the shape and position of the outer two sockets which need to be finished with a chisel, at the same time as you clean up the rounded corners left by the router bit.*

Making the Pins

The pins are made using the positions marked on the face of the machine, or on the Batten.

Place the straight cutter. Set the button and find the Spiral positions from the test sticks. Check the fit of the test stick, then you are ready to make the pins.

Set the Allen Key in the Centre Plate and bring the cutter to its forward position, following the procedure on page 113.

Cut each pin, using the positions given by the edge of the Fixed Fence against the pencil mark.The pockets will have rounded corners. These will need to be sharpened up with a bevelled chisel and angled chisels for the corners.

Section 10

Batch Cutting

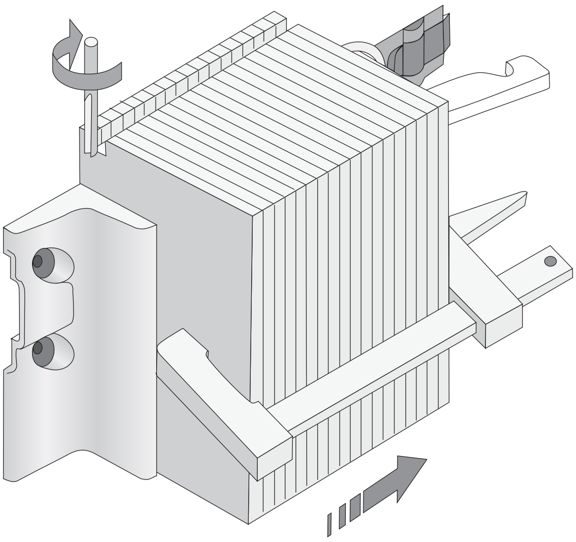
Comb Joints **122**

Dovetails in Batches **124**

Batch Cutting

For batch work, a number of pieces are locked in place and treated as a single block. They can be taped together, or held together with a clamp.

Comb Joints (Box Joints, Finger Joints)



Comb joints are made as a stack. The pieces are clamped together and all passed through the fixed bit as a single block. The bit is brought forward by twice the width of the bit and a second trench is made in the block. The bit comes forward again and a third cut is made, and so on. This makes sockets, and leaves pins between them, each the width of the socket. This is sequence A.

When the next batch is cut the sequence of cuts is offset by a cutter width – Sequence B. This means that one set will fit the other.

Set-up

Batch production tray, and clamp for the stack of pieces.

Guide Rails

Star Knob

A fine pair of dividers or you can generate equally spaced marks using a PC.

Stock

Prepare the sides as one stack. They will have Layout A. The ends will be in the other stack and take Layout B to fit.

Cutter and the Template

Arguably, the narrower the cutter used for finger joints: the better. The fingers look best when the cutter is a lot narrower than the thickness of the box side. There is more work to do, though, because there are more joints.

1. Place your straight bit. Cut a socket in a piece of scrap or acrylic.
2. Set up the first stack using the batch production tray as for batch cutting of dovetails. When all the pieces are square and true, clamp it in cutter position firmly up under the Base Plate.

North-South Registration

The Scale

The position of the cutter as it is brought forward each time and fixed down, is given by a Scale that you make on the Guide Rails. The pointer is an acrylic scrap with a socket cut in it representing the cutter. It is fixed to the Router Plate, overlapping the scale.

Accuracy depends on the even way you lay out the scale on the Guide Rail.

The tightness of fit depends on how accurately you measure the width of the cutter, and the adjustment you make for the glue.

1. Take an adhesive paper strip and stick it down the right-hand rail.
2. Measure the diameter of your straight cutter (D) using a pair of fine and accurate dividers, measuring inside the socket that you cut in the acrylic earlier.
3. Prick off two bit diameters onto a piece of paper, and reset the dividers to two diameters. If you use this dimension, the joint will fit exactly, as a push fit, and there will be no room for the glue. So reset the dividers to a gnat’s whisker less than the two diameters. The difference determines your glue line.
4. Walk the dividers down the label pricking off the measurements to mark out the joint positions A, B, A, B and so on.

   If you have access to a computer you can make marks of total accuracy down the paper, but the old fashioned way is quicker.
5. Depth your cutter to the depth of the stock (or deeper).
6. Bring the cutter to touch the back of the stack with the blades set north-south.
7. Stick the acrylic template with the socket onto the Router Plate (use double sided tape or blu-tac). Place it so that the near edge of the socket lies over the first pin prick. A.
8. Place the Star Knob. Now if you fix the router, set it going, and track it across the stack, it will just graze the back of the stack. Don’t do this but…
9. Bring the router forward to the next A (missing the B) so that the pin prick is just visible under the front edge of the socket.
10. Fix the router with the Star Knob, switch on, and track the block of pieces into the cutter. The cutter will burrow into the wood and come out the other side.
11. Bring the router forward to the next A and cut the next groove. Set up the Router Plate at each pin position, fixing it down with the Star Knob, cutting a groove through the block.

    When Layout B is done…
12. When all are done, cartwheel the whole block (so that the same edges are against the machine face) and repeat the exercise, using the same curser edge, but against the B dots. The first run will be a clean-up run on the edge to avoid tearout.
13. The A ends should now fit into the B ends, and four pieces will go together as a ring.

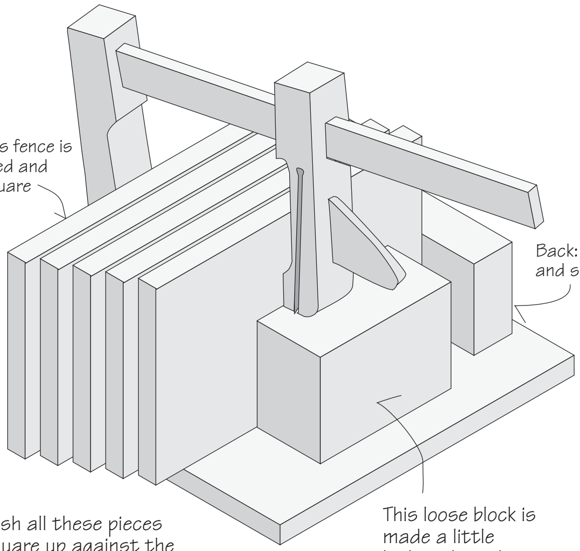
Dovetails in Batches

Dovetail Sockets

The batch cutting technique for finger joints can be easily applied to dovetails

- Set up the drawer/box sides (the pieces for tails) as a single block. Put them in a Batching Tray and clamp them together. They must lay square and true, all exactly against the back of the tray.

  Include four extra pieces. Two will be useful for test pieces and two will become templates.



This fence is fixed and square

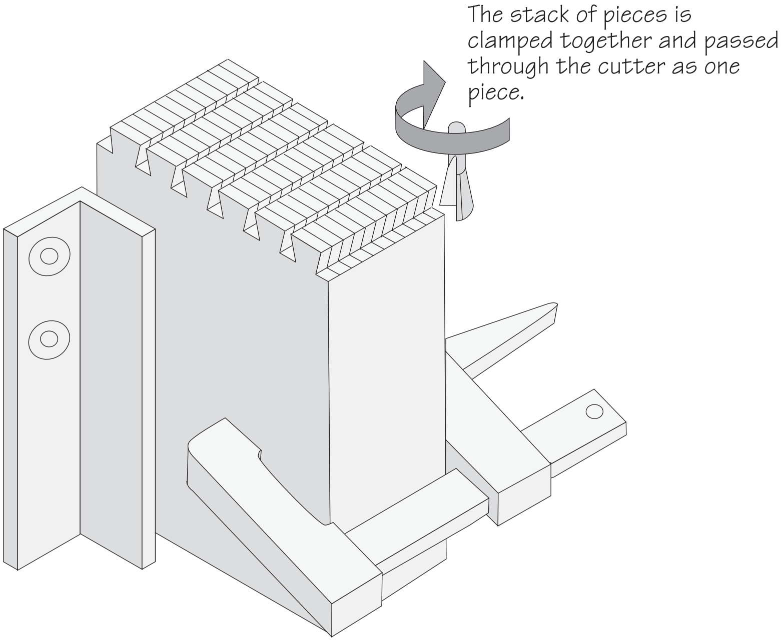
Back: Fixed and square

Push all these pieces square up against the back and the fixed fence.

This loose block is made a little higher than the fixed fence

Batching Tray

- When they're clamped in the machine, plunge the cutter a little, and 'mow' the pieces so that the block is flat and square. Re-set the block up under the Base plate. Each piece is now identical, and the depth of socket will be exactly the same in all of them.
- The first board can have the pin positions marked on it. Do this with the parallelogram.
- Cut the stack, running the whole block through the cutter - fixed and depthed.
- When cutting the edges set the router so that it cuts a trimming cut first to avoid tearout.
- Run the block from right to left to cut the first cut. The middle cuts can go either way, and the front cut needs the block to go from left to right. The cutter then travels correctly clockwise.


The stack of pieces is clamped together and passed through the cutter as one piece.

• When this is done cartwheel the block and mow the block and re-cam it under the plate.

• Mark out the first board and cut the back tails.

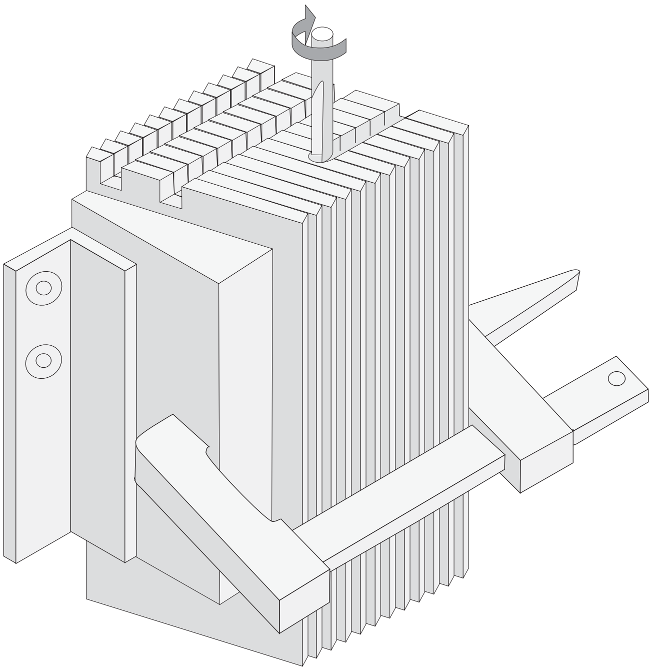
If all the pieces in a stack are placed square in the Lock, and the stack is cut square, each piece will have a square cut.

Successful batch cutting depends on making the pieces lie flat together, they must be equally thicknessed, and they must not move with moisture changes.

If they are recently re-sawn they must as far as possible be kept flat, against their natural tendency to warp, as the stresses are relieved.

When they are jointed, and glued together, the structure of the joint will take care of the warping, but until then, they should be well taped up, and clamped together. If you are cutting slices from a plank or re-sawing, it may be as well to wrap the stack in kitchen film before taping it up. This will stop the moisture getting in or out, and will allow the stack to move within the bands of the tape, so they can be banged down flat and true.

Cutting Pins in Batches



Dovetails sockets are cut square to the board, so there is no problem for box Sides or the Sides of drawers. At first sight this technique cannot be used for the Pins. Indeed the front (half -blind) pins of drawers have to be done by hand from the tails in the usual way, but you can make through pins with this method with a little care:

1. Set up the stack as before. Make a pair of wedges to the angle of the dovetail bit at 1:7 or 1:6 and place them on the ends of the stack. Beat the stack in its film jacket and tape, so that each board is flat on the flat surface, square to the back of the pallet and canted over at 1:7. In other words that the outside faces of the wedges are square. Treat this stack as a single block, and cam it into place under the cutter.

2. The first board is marked out with the socket positions on the end, from one of the boards with the dovetail sockets that you have just made, using a marking knife.

3. Depth the bit to the drawer sides, and run the bit straight down the stack of pieces, cutting one side of each pin. The line is straight, but as each board is canted, each will have a canted (1:7) cut along one side of one pin.

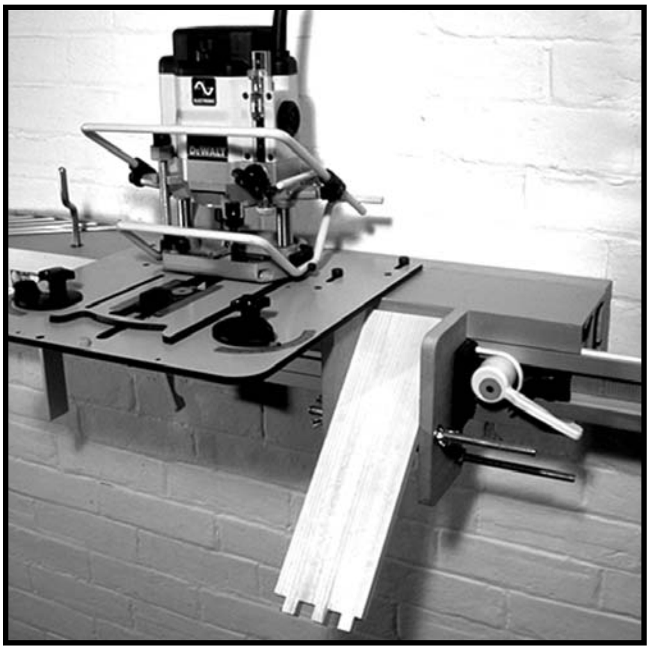
4. Bring the cutter forward to the next pin position and run down the side of pin No2.

Then No.3 and so on

5. Having cut one side of each pin on one end, cartwheel the stack, and repeat for the other end of the stack.
6. Take out the stack and beat down all the pieces to cant them over the other way. Turn the wedges over so that they form square sides to the stack, and return the block to the Cam lock. Now you will see that the other side of the pin can be cut with a straight cut. Complete each pin and cartwheel the stack to finish the pins of the other end.

   It is worth putting a lot of time in setting up the stack and getting it right. It takes patience. If, however, the alternative is hand cutting, it will save you hours if not days of work. The last set that I made was of twenty drawers in a stack. I did not actually bother with the tape and polythene film, and it came out well. It seemed to take ages to line the pieces up in the Batch Production Tray and to get them square and to see that the clamps did not bend the block of boards out of true, but the cutting was so quick that it was well worth the trouble.

Section 11



Jigs & Accessories

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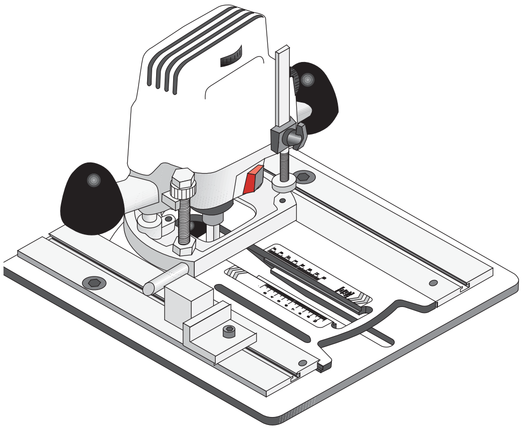
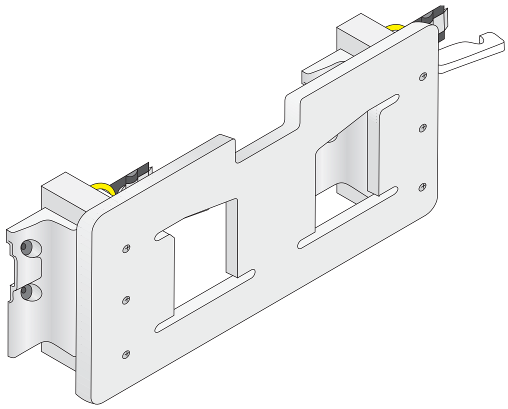
Accessories

Aluminium Guide Rails



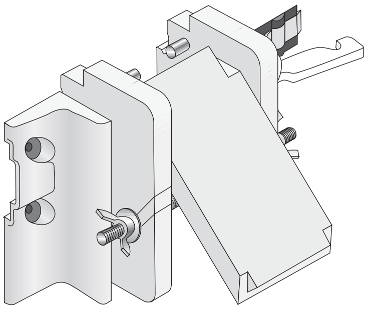
Aluminum Guide Rails now come with a simple yet ingenious stop that turns your 'Rat into a mass-production tenoner. No marking out is necessary, and no scales are used. You get deep, clean, accurate and square tenons in seconds! It's revolutionary, unique and very good value compared with other tenoning systems. The WoodRat will tenon boards up to 30" wide! It will also cut square tenons that are essential when making a haunched mortise and tenon joint for a cupboard door.

Mortise Rail



Used for mortising and raising panels, the Mortise Rail can either be made by you (see page 70), or bought as an accessory. Call us or check out our website at www.woodrat.com.

Mitre Box



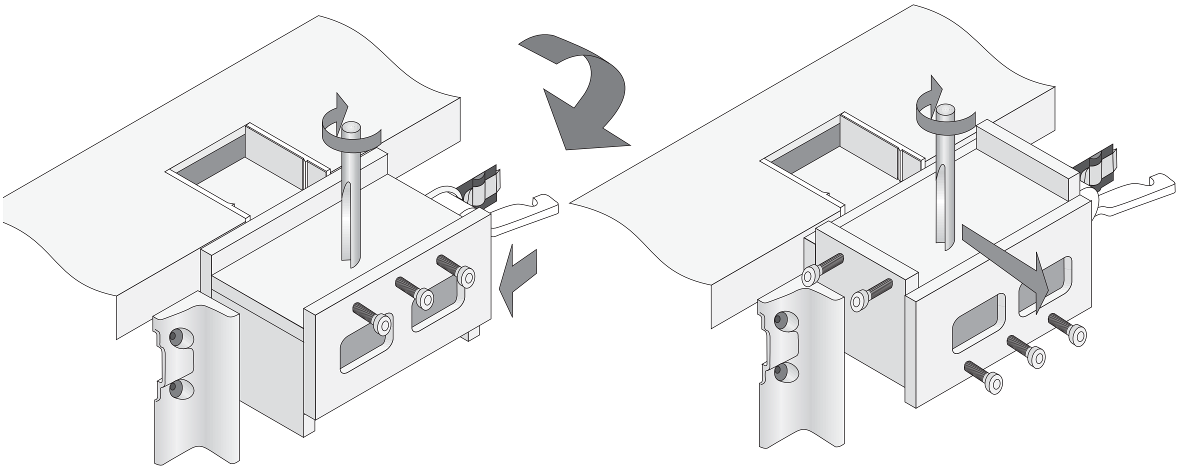
A WoodRat accessory that holds wood to be presented to the cutter at any angle from 0-90 degrees. It consists of two MDF plates and two rods. The lower rod keeps the plates apart against the force of the Cam Lock, the upper rod grips the wood.

Uses include making Mitred Dovetails, Mitred Dowel Joints and Drawer-front Dovetails.

Available from your WoodRat supplier.

Jigs

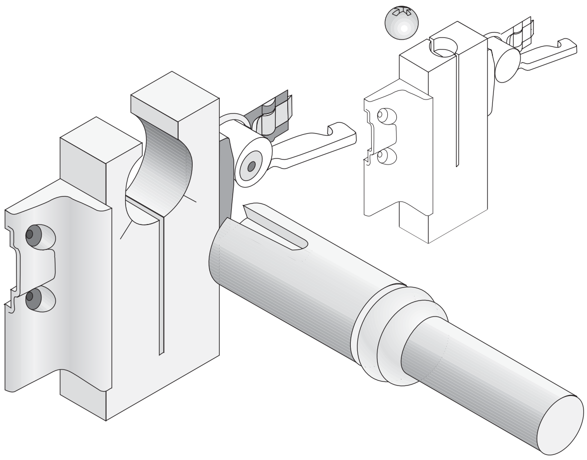
The Box



Boxes can be made in various shapes and sizes for a variety of purposes. Particularly style and rail joints (cope and stick joints) for cupboard doors.

This design of Box can be used both ways up allowing work either Flat Across or Flat Square to the machine face.

The Sugar Tong Vice



Because the zone between the top of the fences and the underside of the Plate is swept continually by the cutters, it is not possible to have anything permanent in this area. The fences are therefore set below the cutting zone, and so they are unable to hold timber close up under the Plate.

This problem is overcome by using a simple secondary vice, that can be chopped about if necessary. The shape of its jaws can be quickly modified to take any sort of workpiece, at any angle. When the vice is too chewed up to be of use, it is simply cleaned down and a new pocket cut in the top.

To Make a Sugar Tong Vice

Take a 4”x2”x12” (100x50x300) piece of softwood, and prepare it very square all round. Saw a 6” (150mm) longitudinal cut in it, so that when it is cammed into the Cam Lock the kerf will close up.

Then, cut a pocket in the top of the piece with a router, to take the work. Insert the workpiece into the pocket, cam it in the Cam Lock and it will be held firmly.

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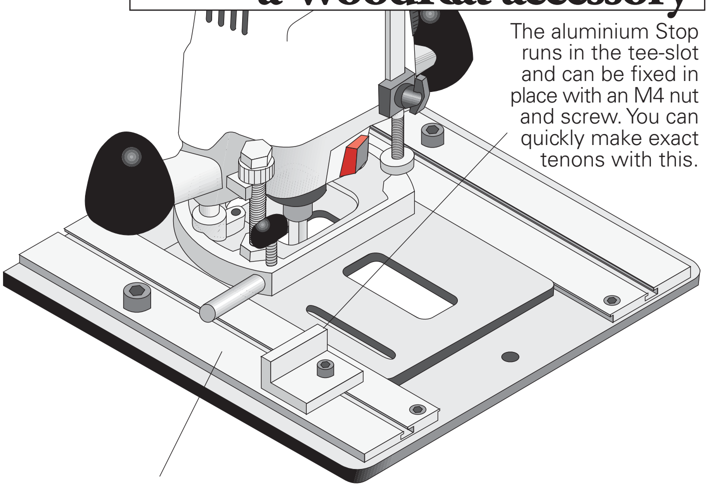
Zeroing the cutter 27

Alu GuideRails™
a WoodRat accessory



The aluminium Stop runs in the tee-slot and can be fixed in place with an M4 nut and screw. You can quickly make exact tenons with this.

The GuideRails comprise two aluminum sections that between them make an easy-glide track for the 'Rat's Routerplate. They firm up the Baseplate, but also the rails incorporate a tee-slot for attaching stops. A Stop is included with the Rails. These instructions give the technique for making perfect tenons.

Setting Up

Slacken the fixing screws and bring the Routerplate forward in the slot, and attach the Alu Guide Rails in place of the 'Rat's plastic rails. Use the M8 45 Caphead screws provided as well as two of the small M4 10 screws in the front counter bored holes. They are long because you may need to gain extra depth of cut by placing the raising plates (see manual).

The Stop requires that you find a suitable Abutment on your router. What form this takes may need some ingenuity on your part, as routers vary. It may be a rod held in the horizontal holes or a projecting fixture mounted on the router plate - anything that hits firmly against the Stop when it's placed in its way.

With the DeWalt 625 fitted with the PlungeBar it can hit the lower bar retaining screw, but you will need to cut down the Stop with a hack-saw so that it hits it cleanly. Alternatively a piece of10mm (3/8")rod placed in the horizontal hole will serve well.

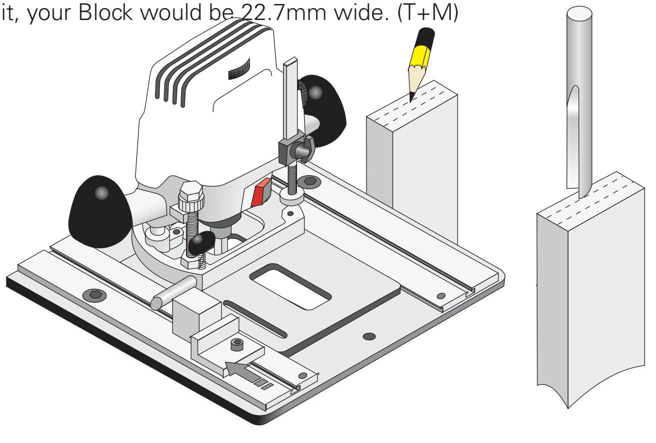
A router without a PlungeBar may use the rod from the router's adjustable fence fixed in the horizontal holes, projecting, to hit the stop. If you have PlungeBar B, C, D or E, you may project the front bar so that it abuts the Stop.

Fix the Stop in place using the supplied M4 10. The nut runs along the tee-slot, and can fix the Stop at any point. It can fit to either left or right rail.

Making the Block

Make a small Block of hardwood exactly the same width as the bit you are cutting the tenons (T) with and the bit you will make the mortises with (M) combined. The tenon may be only 10mm, but can be made with a half inch bit.

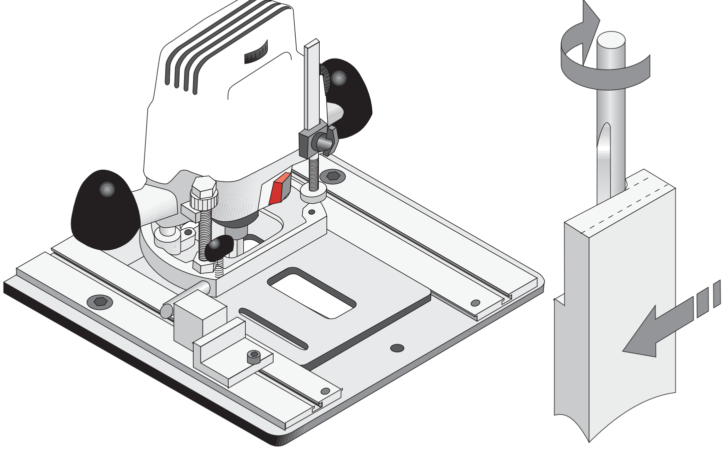
So for example if you plan to make a tenon using the 1/2" (12.7mm) bit, and would like the tenon to fit a mortise made with a 10mm bit, your Block would be 22.7mm wide. (T+M)



Using the Stop to make quick and perfect Tenons

Fit your tenoning bit and before clamping the workpiece into the Camlock, mark up the position of the joint on one rail using a sharp pencil or cutting gauge. Mark the mortise too.

Zero the bit onto the top of the wood. Place the cutter with its blades North-South so that the blade is exactly against the back line. This is the usual WoodRat way of locating a cut.



Place the Block between the Abutment and the Stop. Take the Stop up to the Block and fix its position with the Allen Key. Track the wood to the right, out of the way of the bit.

Depth the depth stop, and plunge the bit.

Pull the router towards you holding it against the Block and the Stop. Switch on and track the workpiece to the left, cutting the first cut at the back of the tenon. Track on past the bit.

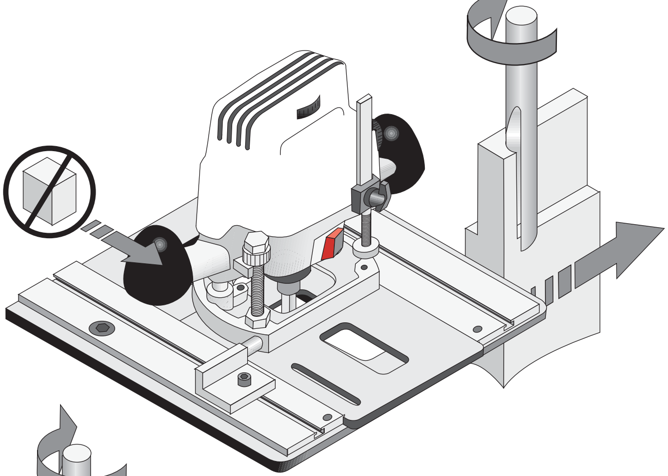
Take out the Block.

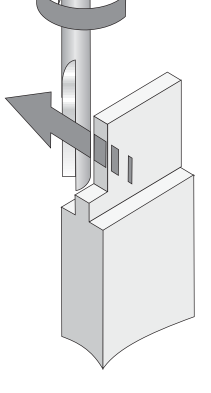
Bring the router forward to the Stop.

Hold the router forward and track the wood right, into the bit to cut the front face.

Take out the workpiece and test the tenon.

The first time you try, you may need to adjust the width of the Block.



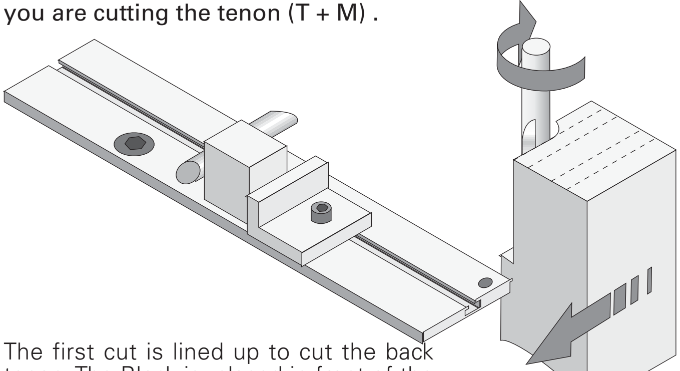


Haunched Tenons

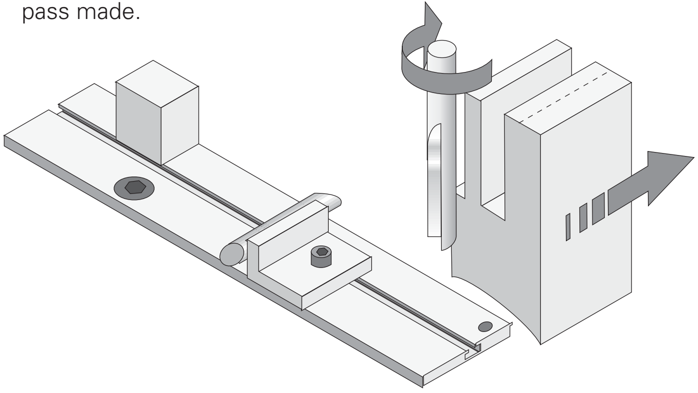
If your tenon needs a haunch, Unlock and raise the router. Keep the depthing foot fixed. Drop the router's depthing foot onto a gauging piece the depth of the panel groove, and re-lock the router. Run the router clockwise across the end of the tenon to make the haunch.

Using the same technique to make Double Tenons

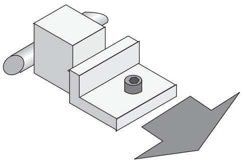
For making double tenon you need to practice the "inch-worm technique". Again, the Block equals the thickness required for the mortise (M) added to the diameter of the cutter with which you are cutting the tenon (T + M) .



The first cut is lined up to cut the back tenon. The Block is placed in front of the rod and the Stop brought up to it and secured. The router is plunged and the first pass made.



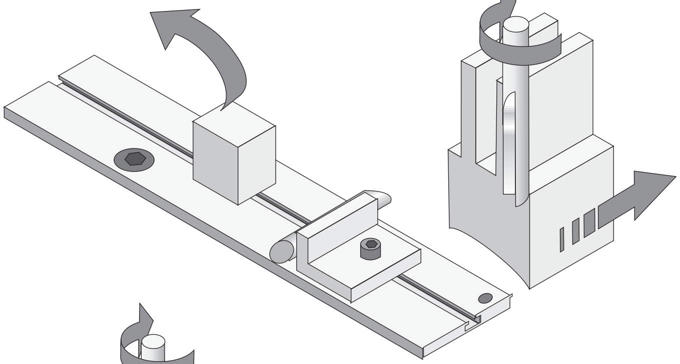
Take out the Block, moving the router forward T+M. Make the second pass to cut the space between the tenons (width T) leaving the first tenon which is the same size as the mortise (width M).

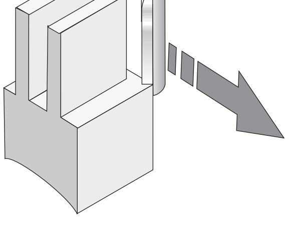


Inch-worming

Now, holding the router still (it could be fixed with the star knob) "inch-worm" the Stop forward, putting in the block between rod and Stop, and then refix the Stop.

Now take out the block. Pull the router forward to the Stop, and cut the front of the second tenon. This has moved the cutter forward by M+T cutting a tenon the exact size (M) of the intended mortise.





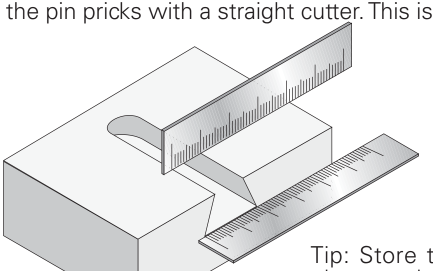
Stub Tenon

The stopped cut to make the stub tenon is simply made by running the router across the end of the tenon in a clockwise direction to avoid breakout.

The Block makes Sliding Dovetails with ease

The technique is essentially the same for sliding dovetails as it is for tenons, except that you must use the same dovetail bit for both socket and tenon and at the same depth of cut. This means that the Block is twice the width of the cut, and that you need a special gauging piece to give the depth of cut – one that matches the block. Once you have made them to fit exactly it would be as well to keep them together on the same piece of string.

Because the dovetail has sloping sides, you will need to take an average width and double it. You can, of course, measure the width of the socket at a point half-way down it and double it, but the easiest way is to measure the bottom of the cut (the diameter of the cutter), and simply add it to the width of the socket at the top of the cut. If you use a pair of dividers, the two measurements can be pricked out onto the top of a scrap piece and the block cut to the pin pricks with a straight cutter. This is quick and error free.



Bottom of the cut is 20mm and the top is 10mm. Therefore make the Block needs to be 30mm wide.

Tip: Store the Blocks in a safe place as they are easy to lose.

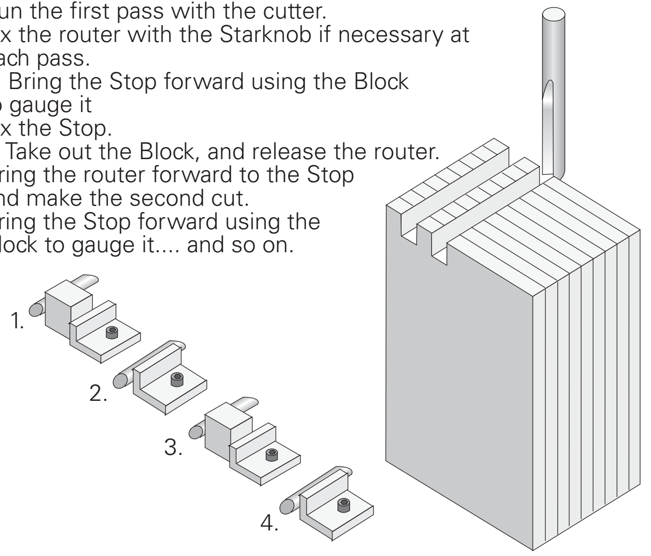
A 2T Block inchworms fine Finger Joints

WoodRat finger joints are best made by cutting a stack of stock and running the stack East-West into the cutter. The cutter is fixed, and comes forward by 2T at each pass. This makes a socket T and a tenon T. If this is too exact, it will leave little room for glue, so the block will need to be a shade smaller than 2T to allow for this.

Cut a trial socket with the bit you are using, and measure it with a pair of dividers.

Make two pin pricks on the end of a piece of scrap hardwood, and swing the dividers to mark out two thicknesses (2T). Cut the Block to these pin pricks with a straight bit. Saw off the block to a convenient size and keep safe.

Follow the inch-worming technique:
1. Put the Blade at the back of the stack of pieces.
Bring up the Stop to the Block in front of the Rod, and fix it down.
2. Take out the Block.
Bring the cutter forward (2T), holding the router against the Stop.
Run the first pass with the cutter.
Fix the router with the Starknob if necessary at each pass.
3. Bring the Stop forward using the Block to gauge it
Fix the Stop.
4. Take out the Block, and release the router.
Bring the router forward to the Stop and make the second cut.
Bring the Stop forward using the Block to gauge it.... and so on.



For very small boxes it could be better to leave the material as a solid block, make the joint and then slice the pieces off afterwards, planing or sanding the block before each slice.